Compressed Air Magazine

VOLUME 46 · NUMBER 3 MARCH 1941 LONDON · NEW YORK · PARIS

CHURCH IN BRAZILIAN MINING CAMP

"I BOUGHT HORSE POWER NOT ELEPHANT POWER AND SAVED MONEY"

"For small H.P. jobs, I used to buy large-size steam turbines . . . until I learned Coppus makes small sizes. Now I fit the job with a Coppus turbine sized close for my requirements — and save plenty in investment cost."

ANOTHER COPPUS BLUE RIBBON PRODUCT... DESIGNED FOR YOUR INDUSTRY

Coppus offers six sizes from 150 H.P. down to fractional — with prices to correspond. Thus you don't have to invest in Elephant Power that you don't need. And here is the story behind Blue Ribbon *performance:*

1. Precision workmanship, controlled by Johansson Size Blocks.
2. Dynamometer tested before shipment.
3. Partial load economy by individual nozzle control.
4. Encased governor, slow speed, leverless.
5. Separate safety trip, pilot-operated, leverless.
6. Vertical or horizontal types; also with built-in speed reducer.
7. Steam, air or gas-operated.

So look for the blue band around the flange. It identifies top quality at an investment cost in line with your requirements.

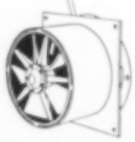
87% REPEAT ORDERS!

The true sign of a Blue Ribbon value: 87% of Coppus Steam Turbines sold in 1940 were repeat orders! Complete facts sent on request. Ask for Bulletin 135-9 using this coupon. Address Coppus Engineering Corporation, 230 Park Avenue, Worcester, Massachusetts.

ASK FOR FREE BULLETINS ON THESE OTHER COPPUS BLUE RIBBON PRODUCTS

(Check the ones that interest you)

☐ **COPPUS AIR FILTERS.** For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.



☐ **COPPUS-DENNIS FANMIX GAS BURNER.** New method of mixing gas and air insures perfect gas-air ratio — instant, complete combustion. Bulletin 410-2.

☐ **COPPUS CABLE MANHOLE AND TANK VENTILATORS.** For any confined working space. Special adaptations for boilers, tank cars, shipholds. Bulletin 163-1.

☐ **COPPUS HEAT KILLERS.** Keep production up by keeping men cool. No stale air recirculation. Air is directed. Bulletin 160-4.

☐ Also send Bulletin 135-9 on Coppus Steam Turbines.

ALL COPPUS BLUE RIBBON PRODUCTS

Designed for Your Industry
Engineered for You

Name _____

Company _____

Address _____

City _____

Sales Offices in THOMAS' REGISTER. See Sweet's Catalog for other "Blue Ribbon" Products.

COPPUS

More than a "Separator"

PROTECTOMOTOR PIPE LINE FILTER DELIVERS *Clean* AS WELL AS *Dry* AIR

Rust, Pipe Scale, Dirt and Dust removed in addition to Water and Oil

Repeat orders from hundreds of leading American concerns prove that Protectomotor Pipe Line Filters save money, speed production. Easy and quick to install, Protectomotors have often saved their entire cost in a single month.

Find out how in your operation Protectomotors will increase output, add to profits.

WRITE FOR CATALOG; also Data Form for Free Analysis of your requirments.

STAYNEW FILTER CORP.
7 LEIGHTON AVE., ROCHESTER, NEW YORK
Air Filter Headquarters

FILTERS FOR PIPE LINE, ENGINE INTAKE AND BUILDING VENTILATION

Nose-Diving Mercury Means Moisture Condensation in Air Lines

When warm air enters cold pipe lines, moisture condenses. Unless removed, the water so formed washes oil from air-powered tools; freezes and causes clogging; injures valuable merchandise; interferes with delicate processes.

Model CPH

Positive Action ★ Exclusive Construction

As air strikes Aluminum Baffle (2) most water, oil and heavier particles are thrown to sides of Container (1), draining to bottom where excess is drawn off thru Drain Cock (5). Passage of all wet or dry matter is positively prevented by exclusive Feltex dry-type filtering medium in patented Radial Fin Insert (4). Only clean, dry air is delivered.

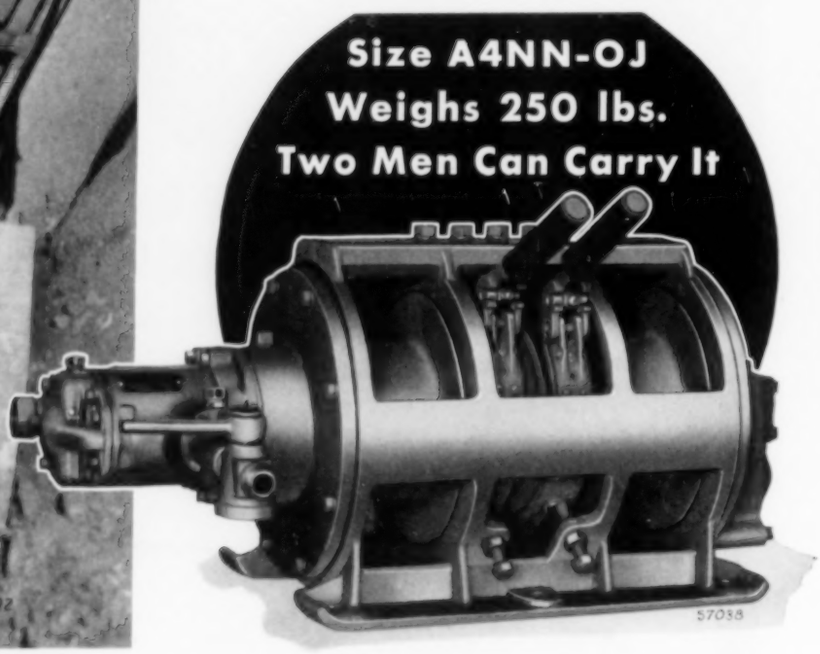
PROTECTOMOTOR AIR FILTERS

YOU NEED PROTECTOMOTOR MORE THAN EVER IN WINTER

New Lightweight Scraper Hoist Pays for Itself in Four Weeks!

This double-drum air hoist is pulling a 30-inch all welded scraper an average distance of 60 feet to the chute. 15 tons are mucked per hour.

Western Lead-Zinc Mine Uses New I-R Portable Air Hoist in Narrow Stopes



THE introduction of the new lightweight, double-drum, air hoist for scraping in narrow stopes has opened a field for very substantial reductions in mucking costs. At one lead-zinc property, such savings pay for a hoist in four weeks' time.

Longer blocks of ore can now be worked out in less time than was required for the shorter blocks when they were formerly mucked by hand. The distance between chutes has been increased, thereby cutting down on raise development per ton of rock handled. Furthermore, since the blocks are mined quicker, major savings are made in stope retimbering and repairs.

If you are faced with production problems on "short-jobs" in narrow, hard-to-handle stopes, ask an I-R man for the facts about this new unit. It is the lightest hoist of its type. You will find it a real money maker and time saver.

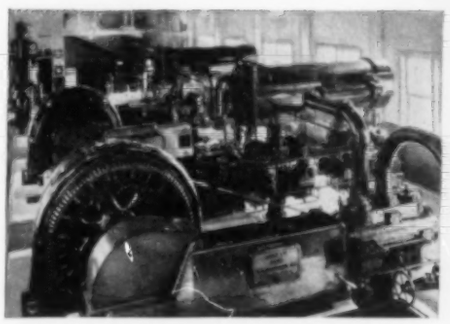
Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

992-B

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Knoxville, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, St. Paul, Tulsa, Washington

Opens Wide Closes Tight



BURY 2-Stage Air Compressors, 180 r. p. m., in Idaho, 100% lubricated with *Texaco Algol Oil* since 1929.

THAT'S HOW a hippo's mouth operates . . . and that's how the valves in your air compressors *should* operate.

In the service of contractors where dependable operation is essential, thousands of compressors are delivering full pressure at minimum cost... and valves keep CLEAN months on end with *Texaco Alcaid, Algol or Ursa Oils.*

These highly stable lubricants resist gumming, sludging and the formation of carbon deposits, assuring more efficient valve action and longer service between inspections.

The outstanding performance that has made Texaco preferred in the contracting field has also made it preferred in fields listed in panel.

Buyers in these fields are enjoying many benefits. You, too, will find important advantages when you use Texaco Lubricants and Fuels.

A Texaco Lubrication Engineer will gladly cooperate in securing more dependable operation of your equipment. Phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write: The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More railroad rolling equipment in the U. S. is lubricated with Texaco than with any other brand.

★ More tourists use Texaco *Fire-Chief* Gasoline than any other brand.

★ More scheduled airline mileage within the U.S. and to other countries is flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More copper is produced in the U. S. by mines using Texaco Products than by all other copper mines combined.

★ More stationary Diesel horsepower in the U.S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U.S. is lubricated with Texaco than with all other brands combined.

TEXACO DEALERS INVITE YOU TO ENJOY

FRED ALLEN in a full-hour program every Wednesday night, CBS, 9:00 E.S.T., 8:00 C.S.T., 10:00 M.S.T., 9:00 P.S.T.

METROPOLITAN OPERA every Saturday afternoon, NBC. See local newspaper for time and station.

TEXACO

REG. T.M.

TEXACO Lubricants

FOR ALL COMPRESSORS AND AIR TOOLS

EIMCO

STANDS FOR *Money-Saving Quality and Performance*

Mining men often ask us what EIMCO means and we are always glad to explain that the word was "made up" a number of years ago from the initial letters of our original corporate name—Eastern Iron & Metals Company—when that name no longer suited our location and the rapidly expanding scope of our operations.

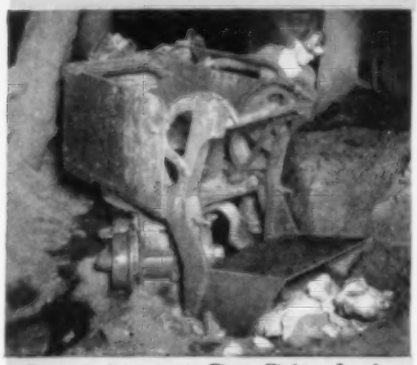
To thousands of mining men throughout the United States and many other countries, however, the word EIMCO has come to have another meaning—derived from money-saving experience with Eimco-Finlay Loaders, Eimco Continuous-Vacuum Filters, Eimco Super-Molychrome Liners and other modern Eimco products for the mining and metallurgical industries. These men, whose opinions are based on actual results, KNOW that EIMCO stands for a higher standard of quality and performance than has ever before been available to users of mining and milling equipment.

This world-wide reputation for superior products and engineering service hasn't "just happened." Back of it is one of the largest and most completely equipped plants possessed by any manufacturer of mining and milling equipment. For more than a quarter of a century its several divisions (see note below) have been furnishing iron and steel castings, structural steel and plate work, steel forgings, machine-tool work and special machinery of all kinds to leading mining, railroad and industrial companies throughout the United States and many other countries. New equipment and personnel are constantly being added to permit taking full advantage of every important technological advance.

Applied to the manufacture of mining and milling equipment these complete facilities assure higher standards of quality and more dependable deliveries than would otherwise be possible. Complete control of every step in production enables us to eliminate many difficulties and delays which are unavoidable when work must be "farmed out" to other plants. Another advantage, of even greater importance to most buyers, is the reduction in unit overhead costs achieved through the large volume of work constantly passing through our shops. Savings thus secured are amplified by the use of modern production equipment not available in smaller plants and largely passed on to purchasers.

Illustration below shows main building of Eimco Corporation in Salt Lake City, containing machine shops, assembling and shipping departments. Steel and iron foundries, pattern shops, structural steel and forge shops, plate and tank shops, etc. (operated by two wholly-owned subsidiaries, the American Foundry & Machine Co. and the Structural Steel & Forge Co.) occupy suitable buildings on adjoining properties.

EIMCO-FINLAY MINE-CAR LOADERS

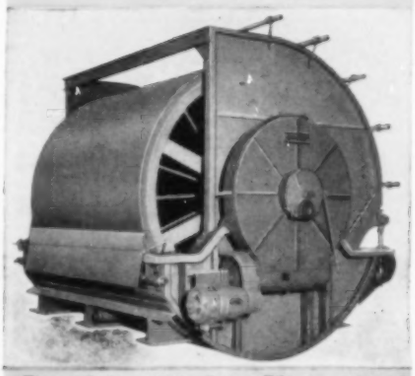


One of the many Eimco-Finlay Loaders used by a world-famous copper-mining company. This "Model 21" fills a 65 cu. ft. Granby-type side-dump car with ease.

Year after year, far more Eimco-Finlay Loaders are manufactured and sold than all competitive types combined, and their inherent superiority has been so thoroughly proved that every machine sold now carries a positive money-back guarantee that it will outlast and out-perform any other mucking machine on the market, of comparable size and type, at any air pressure and under any working conditions. Model 12-B (powered by two five cylinder radial air motors) operates efficiently in drifts as small as 4 ft.-6 in. wide by 6 ft. high—loads mine cars up to 50 cu. ft. capacity at the rate of a ton per minute. Other models are equally efficient for loading larger cars, up to the largest sizes used underground. Bulletin 105 gives complete information.

This Eimco-Finlay Loader saves $800 every month for a New Jersey Iron-Mining Company in comparison with former hand-loading methods and costs.

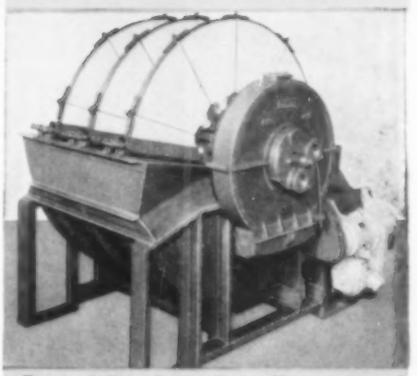
EIMCO CONTINUOUS-VACUUM FILTERS



Eimco 8 ft. x 8 ft. Drum Filter, equipped with wash frame and spray nozzles for cyanide service. Note low drum submergence and invert cake discharge.

Retaining all good features of the best continuous-vacuum filters previously available, and embodying many important new-feature improvements, Eimco Drum and Disc Filters are rapidly superseding all others in modern concentrating mills and metallurgical plants.

Eimco Drum Filters are widely used for washing and dewatering cyanide slimes, for removing residues from both acid and alkaline leaching solutions, and for many other washing and dewatering operations in the metallurgical and chemical-process industries. Eimco Disc Filters are unequalled for dewatering flotation concentrates or tailings. Bulletin 402 gives complete information regarding design, construction and operation of both drum- and disc-type filters.



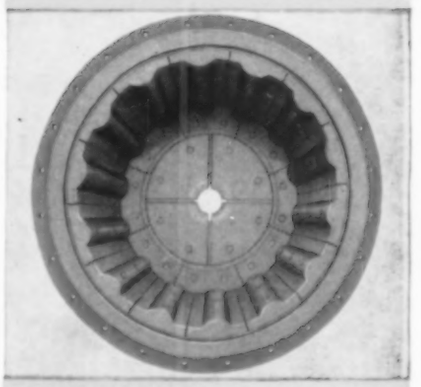
Eimco 3-disc, 6 ft. diam. filter equipped with vari-speed drum drive. This type of filter is available in a wide range of sizes, up to 12 discs—each 12 ft. in diameter.

EIMCO SUPER-MOLYCHROME LINERS

Car load of Eimco Super-Molychrome Liners ready for heat-treatment in modern electric oven equipped with automatic temperature control, which assures best results.

Reports and repeat orders received during the past two years from scores of well-known mining companies prove conclusively that no other type of lining material for ball, rod or tube mills can approach Super-Molychrome for durability, or for economy when measured by the amount of ore ground. In many cases it has given double the service-life secured from the best lining material previously used.

Trial orders carry a money-back guarantee of at least 15 per cent saving in net cost, per ton of ore ground, as compared with that of any other lining material previously used under the same operating condition. The same guarantee applies to Eimco Cumocrome crushing plates for any size or type of jaw crusher.



Eimco Wave-type Super-Molychrome Liners in typical center-discharge-overflow ball mill. We have liner patterns for practically all other types of ball, rod and tube mills.

THE EIMCO CORPORATION
SALT LAKE CITY, UTAH, U.S.A.

NEW YORK
120 Broadway

CHICAGO
111 W. Washington Ave.

EL PASO
Mills Building

SACRAMENTO
1217 7th St.

Sales Representatives in all principal countries throughout the Mining World

THE EIMCO CORPORATION, Salt Lake City, Utah

Gentlemen: I would appreciate receiving further information regarding the products checked below, with the understanding that no charge or obligation of any kind will be incurred.

☐ LOADERS ☐ FILTERS ☐ LINERS

Name ..... Position or title .....

Company .....

Address .....

Water's No Worry—

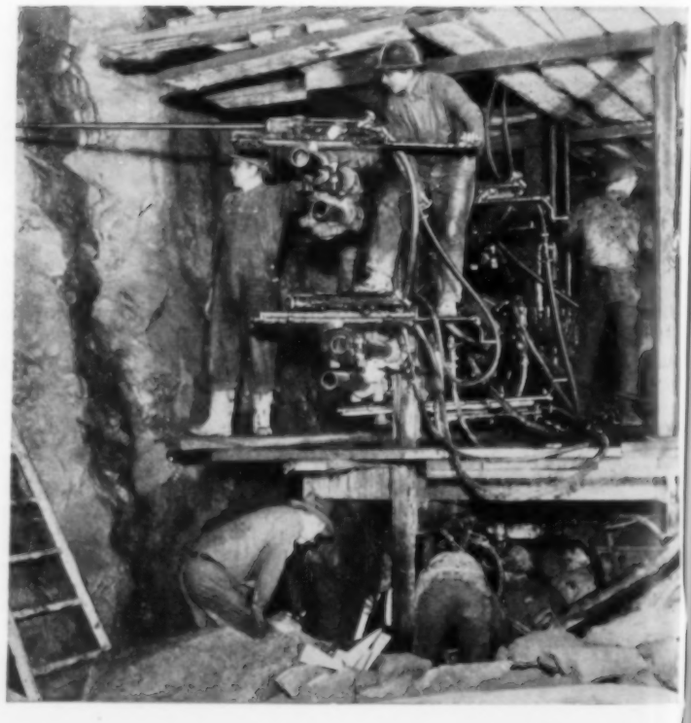
WITH GARGOYLE VOCO ENGINE OIL NO. 1— CORRECTLY APPLIED IN YOUR AIR DRILLS!

EFFICIENCY WON'T WASH AWAY with Gargoyle Voco Engine Oil No. 1 in your air drills.

Water condensed from air may wash off the oil film in poorly lubricated drills.

But this famous oil sticks tight . . . won't wash away.

It helps seal pistons against blow-by . . . provides maximum resistance to cylinder wear. That's correct lubrication.



CALL IN **Socony-Vacuum for**

WHEN YOU CALL IN SOCONY-VACUUM, you profit from these four important lubrication advantages:

1. SKILLED LUBRICATION COUNSEL of a Socony-Vacuum Man backed by 75 years' experience . . . greatest in the petroleum industry.

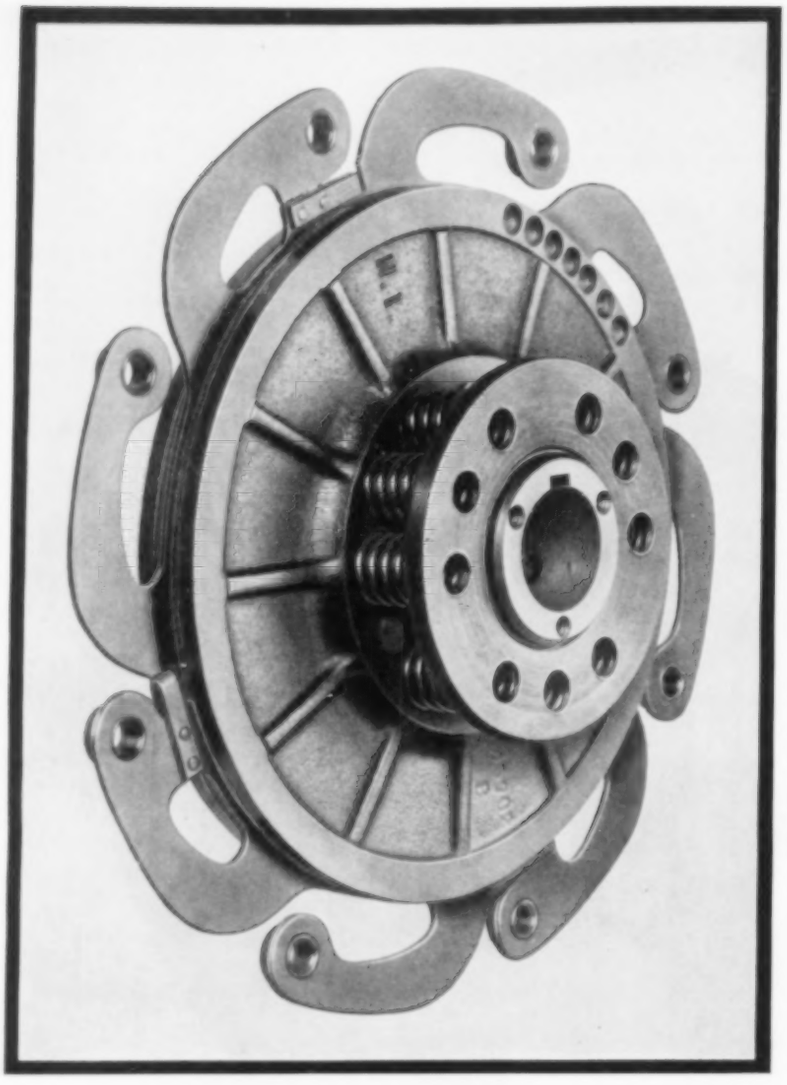
2. A COMPLETE LINE OF LUBRICANTS . . . a scientifically correct oil or grease for each and every job in your plant.

3. NEW LUBRICANTS ahead of new needs . . . developed in close cooperation with machine builders by the famous Socony-Vacuum Research Laboratories.

4. HALF-A-MILLION CASE HISTORIES behind the recommendations of our engineers.

SOCONY-VACUUM OIL CO., INC.—Standard Oil of New York Division—White Star Division—Lubrite Division—Chicago Division—White Eagle Division—Wadhams Division—Magnolia Petroleum Co.—General Petroleum Corp. of Cal.

"Correct Lubrication"



Flex-Disc CLUTCHES

The *Flex-Disc* Clutch was designed in collaboration with Ingersoll-Rand's engineers to meet the exacting requirements of air compressor service, and has been tested and proved during five years. Its specific advantages are:

1. Positive connection between flywheel and drive disc through resilient links, eliminating any possibility of looseness or wear at this point.

2. Spring loaded, non-adjustable driven disc keyed solidly to the compressor shaft preventing looseness or wear between clutch and shaft.

3. Drive plate quickly detachable in segments for relining worn facings without disturbing any other part of engine-compressor assembly.

4. No dragging between driven and driving discs when clutch is disengaged and no running contact between throw-out collar and clutch when compressor is operating.

INDUSTRIAL CLUTCH COMPANY

Waukesha Wisconsin

50 years

Dr. Edward Goodrich Acheson whose inventive genius in creating the first man-made grinding material gave such impetus to the development of abrasive products that they have become all important factors in making possible vastly increased production and greater precision throughout all industry.

● Never before in history has life been so enriched by scientific discovery and industrial progress as in the half century just completed. We have seen amazing strides in means of transportation . . . the automobile, the airplane, the streamlined train of stainless steel. The electric furnace has given industry new chemicals, new steels, new alloys. We have witnessed the creation of new synthetics, the perfection of the machine tool, the enormous development of mechanical efficiency in every field and the production of countless commodities that promote and protect our way of life.

Of all these varied advances none surpass the progress made in the abrasive field. When Dr. Edward Goodrich Acheson created the first man-made abrasive fifty years ago, little did he foresee that modern abrasive products would become one of industry's most important tools for the shaping, grinding and finishing of almost every device of the useful arts. It shapes the tiny balances of our watches. It smooths the massive casting. It grinds tons of wood pulp for paper making. It fashions marble and stone, finishes wood and leather and sharpens the tools of every craft.

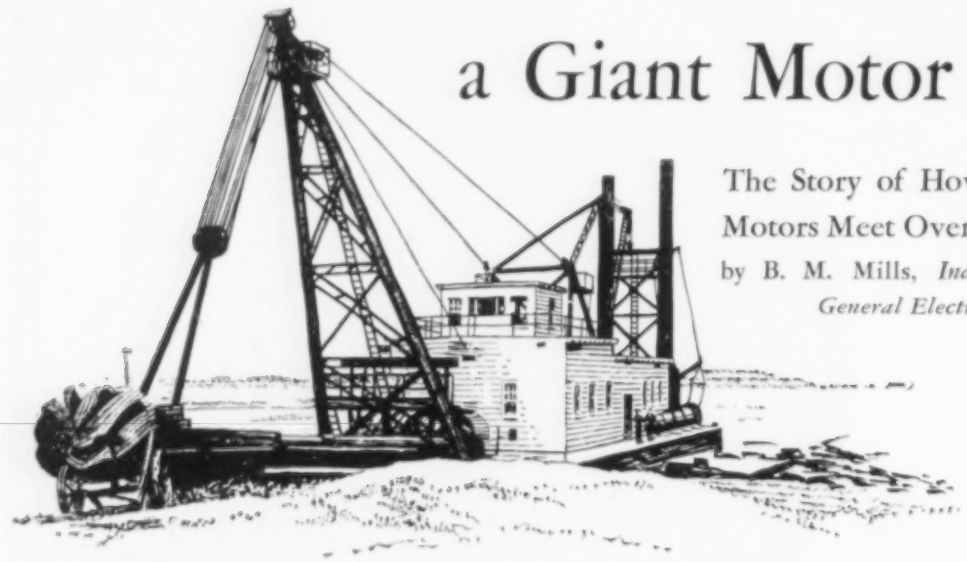
In other words manufactured abrasives are intimately integrated with the very structure of industrial life . . . meeting its fundamental needs, furthering its progress, translating yesterday's luxuries into today's commonplace necessities.

It is with justifiable pride, therefore, that we of The Carborundum Company pay tribute to the late Dr. Edward Goodrich Acheson in commemorating the Fiftieth Anniversary of his creation of silicon carbide, trade named "Carborundum," the first man-made abrasive. It is fitting also that we choose this occasion to acknowledge the splendid cooperation of our friends in industry in bringing his work to fruition and to rededicate this Company's efforts to a continuing service to industry and to the betterment of America's way of life.

Frank J. Tone

FRANK J. TONE, *President,*
THE CARBORUNDUM COMPANY,
NIAGARA FALLS, N. Y.

The *Extra Lung* that Keeps a Giant Motor Healthy



The Story of How Dredge-pump Motors Meet Overload Conditions

by B. M. Mills, *Industrial Department, General Electric Company*

THE problem of getting an electric motor that can power the main pump of a hydraulic dredge dependably and economically under all conditions is one of the severest facing general contractors. Unless a dredge motor is properly designed, it will grow old long before its time because of the large amount of overload service it must perform.

To cope with this situation General Electric engineers have designed a motor to which an extra "lung"—a suction blower—is easily added when the motor is greatly overloaded. This design simplifies the change-over to forced ventilation in order to increase the air circulation around the motor, and reduces maintenance expense.

For the Tough Jobs

It would be easy to supply a satisfactory motor if the pump and impellor characteristics, digging conditions, and heads were all known and fairly constant. But contractors often have jobs where a dredge must maintain yardage against an additional 1,000 feet or so of line, a few more feet of lift, or to produce additional yardage at low heads. Failure to overcome these obstacles easily often means the difference between a heavy loss and a good profit on a job.

If the motors are not properly designed to handle overloads under the usual unfavorable dredge conditions, there may be many bad results. Overheating of the insulation and overloading of the brushes, collector rings, and bearings shorten the life of these parts and contribute to excessive maintenance, expensive shutdowns, and lost yardage.

One method of solving this problem of extreme overloads is to install a greatly oversized motor. But this causes unnecessarily high first cost of the drive. It may increase the hull size of the dredge and handicap it in maneuvering. And such a motor uses too much power under moderate digging conditions when it is running underloaded at reduced efficiency and power factor.

B. M. MILLS

Affords Several Advantages

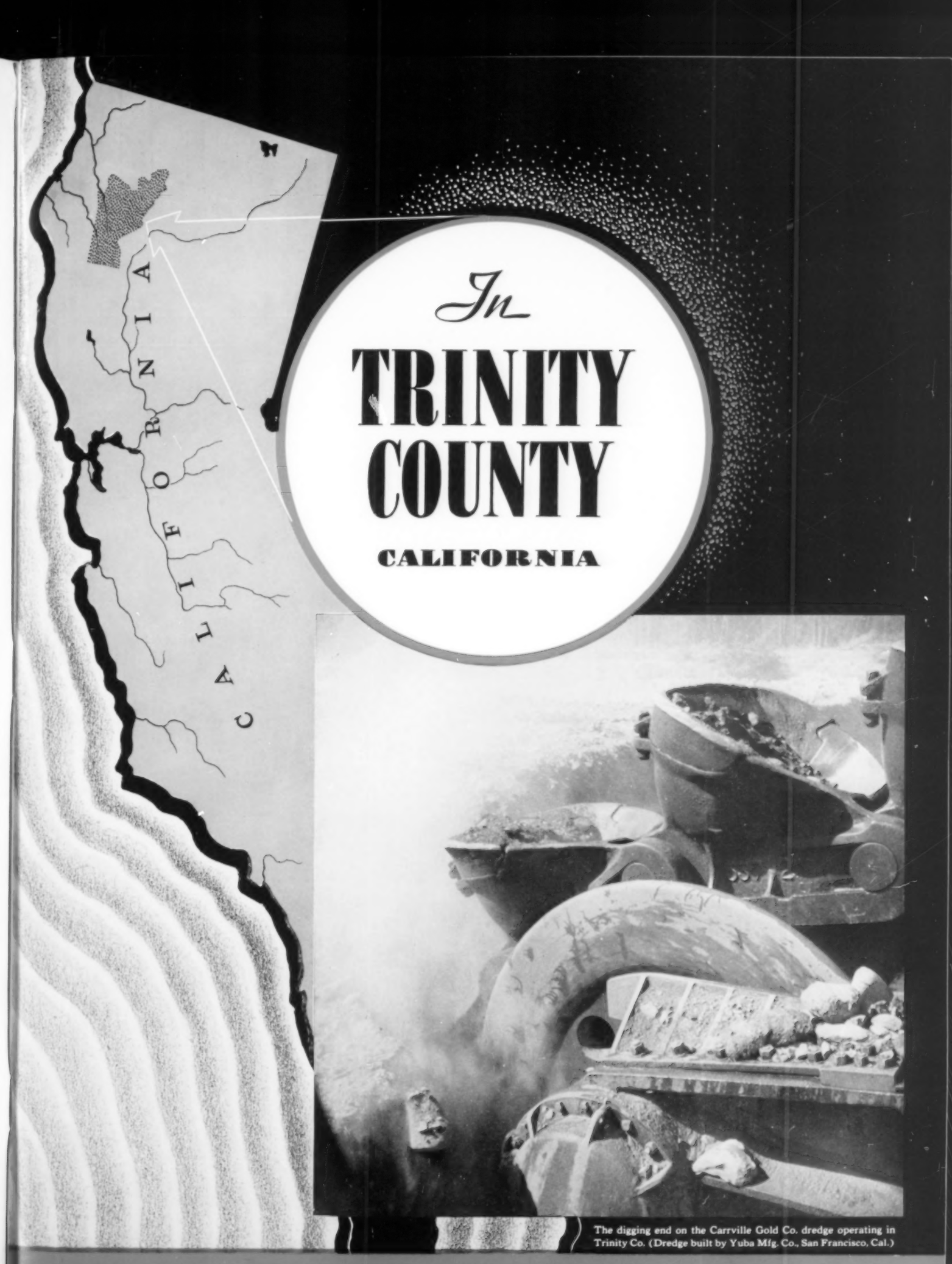
Our heavy-duty dredge-pump motor, designed for high-maximum running torque, handles overloads more economically. The stator frame is so arranged that, with no modifications except a negligible change in the cover plates, a suction blower can be added. This supplies the extra cooling air needed to prevent injurious heating and thus increases the permissible output of the motor by at least 30 per cent.

There are other features in this motor which help minimize maintenance expense, and increase yardage by preventing unnecessary shutdowns, but which don't materially increase the weight of the drive. These include oversize collector rings, extra brush current capacity, oversize shafts and bearings, and extra-sturdy fabricated-steel stator frames and rotor spiders. The motors are also specially insulated to protect against excessive moisture, winter shutdown, dirt, and other unfavorable conditions.

This simple solution of a common problem is another contribution by General Electric engineers to electrical progress in the construction industry. If you have any electrical engineering problems on your jobs, we'd like the opportunity to help you solve them. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

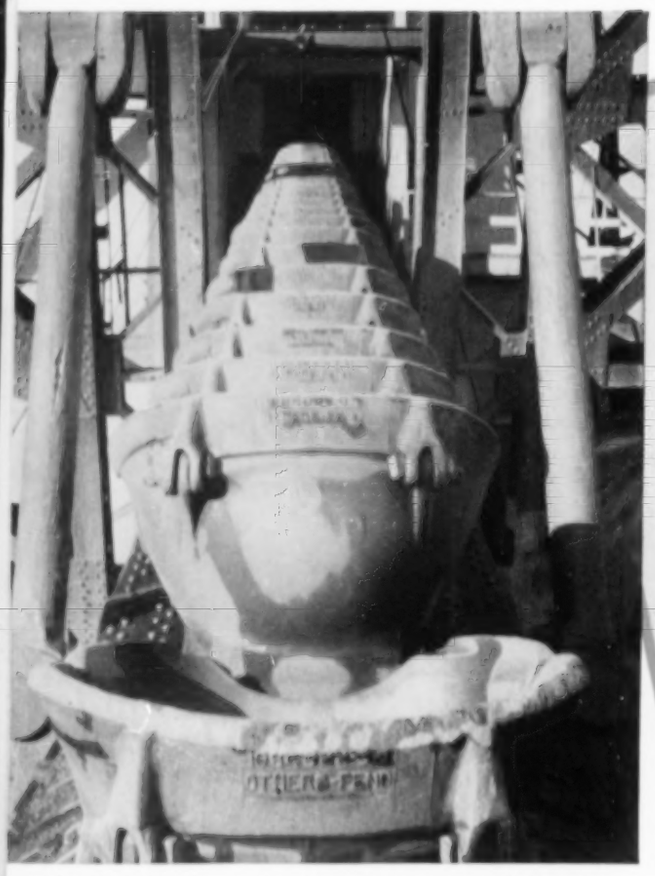
656-13



The digging end on the Carrville Gold Co. dredge operating in Trinity Co. (Dredge built by Yuba Mfg. Co., San Francisco, Cal.)

where the digging is d*!:† tough!...

IN TRINITY COUNTY, and in other placer fields where buckets get real punishment...



In Siskiyou County . . . the Yuba Consolidated Gold Fields Callahan Dredge . . . also TISCO equipped. (Dredge built by Yuba Manufacturing Company, San Francisco, California.)

TISCO

RIVETLESS BUCKETS

are used, because only the TISCO design provides firmly locked lip ends . . . lips which can't loosen, can't shift, can't rip off, no matter how tough the digging!

TISCO Rivetless Buckets and Lips are patented in the U.S.A. and foreign countries.

It makes a world of difference whether the lip is firmly *locked*, or merely *attached*, to the bucket hood. Huge boulders and tough digging quickly loosen the lip ends, often rip off the lip, where there is no positive locking method provided. But this *cannot* happen with a TISCO lip. For the TISCO design provides deep hood pockets which firmly "lock" the lip in place. The lip can't move, no matter how tough the digging. And TISCO design provides many other features which prevent maintenance woes . . . keep costs at a very minimum. Let us send you all the facts!

TAYLOR-WHARTON IRON AND STEEL COMPANY

HIGH BRIDGE, NEW JERSEY, U. S. A.

PLANTS AT HIGH BRIDGE, N. J.—EASTON, PA.

Offices: BOSTON CHICAGO CLEVELAND DETROIT NEW YORK PHILADELPHIA PITTSBURGH SCRANTON SAN FRANCISCO

Montreal, Quebec • London, England • Penang, Straits Settlements • The Hague • Dutch East Indies

Low Cost

OUTPUT *for* SALE

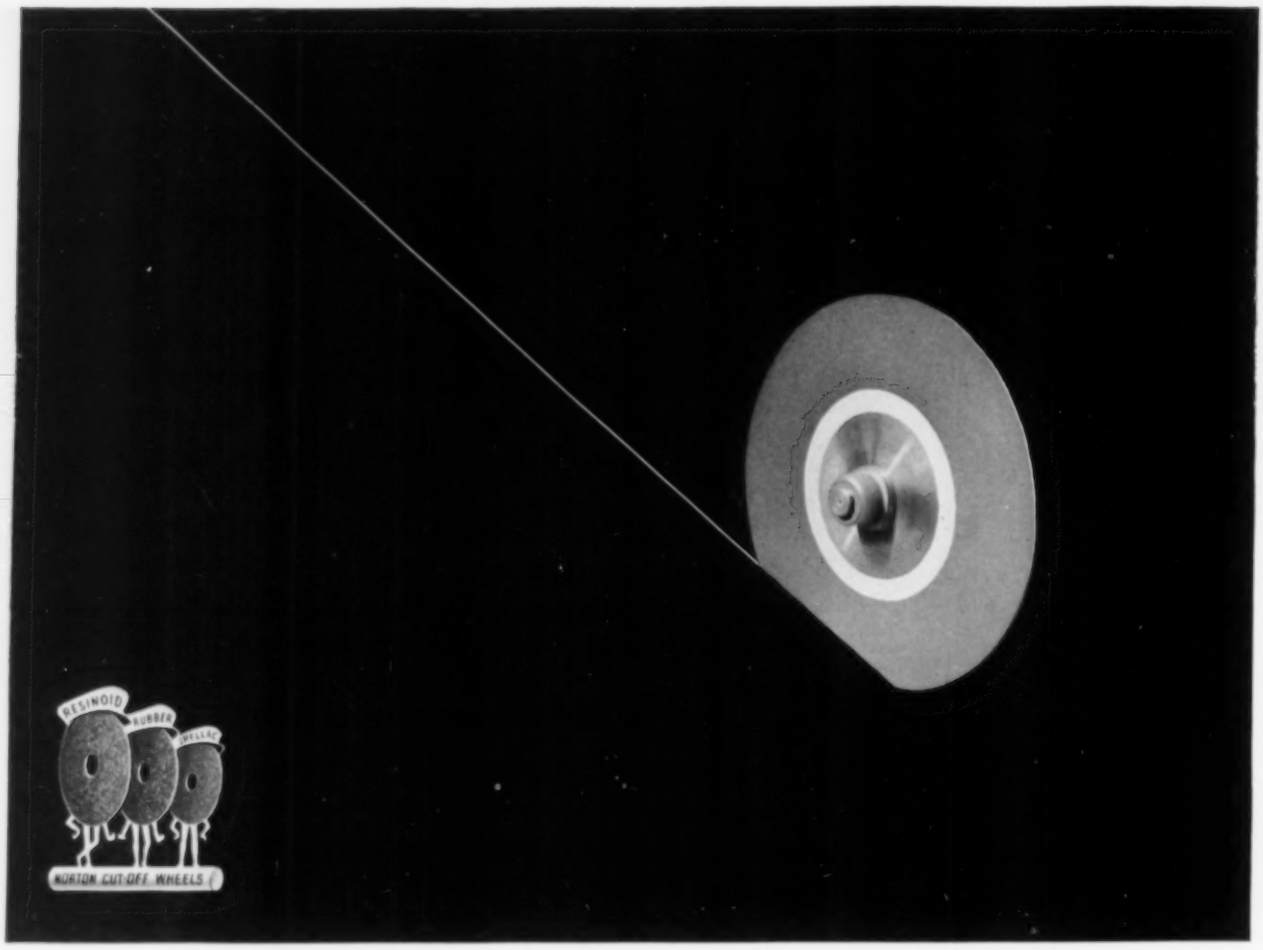
When you put a Bucyrus-Erie 120-B on your job, you know you're going to get performance that means output at bottom costs. These modern excavators have been proved for you by acceptance of leading mines and quarries all over the world. Outfits that know to a penny what it costs them to move rock and ore have tested Bucyrus - Eries thoroughly — and have bought more of them than of all other quarry and mining shovels combined.

When your job demands a shovel or dragline to move big yardages fast and at low cost, investigate Bucyrus-Erie's complete range of modern excavating equipment. Here's a line that has been proved in the toughest digging there is!

BUCYRUS ERIE

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN



Are You Taking Full Advantage of Cut-off Wheels?

There's a Norton Bond for Each Cutting Job—Metallic or Non-metallic Materials

Resinoid Bond is usually first choice for metals when a fast cutting action plus long wheel life are desired and where some burr is not objectionable; also for the dry cutting and slotting of concrete, plastics, fibre and other non-metallic materials. Norton research combined with Norton control in manufacture have resulted in a Norton Resinoid Cut-off Wheel that is outstanding in performance.

Rubber Bond is the choice where minimum burr is essential and for most wet cutting jobs—both metallic and non-metallic materials. For this work, too, Norton research has developed an outstanding wheel.

Shellac Bond is most used in the tool room where its soft, free grinding action is an advantage in cutting tool steels without discoloration.

You can be sure that one or more of these Norton bonds with either Alundum or Crystolon abrasive will handle your cut-off jobs. And a Norton engineer will be glad to help you.

The booklet "Norton Cut-off Wheels" contains much helpful information and it will be sent free on request.

NORTON COMPANY
Worcester, Mass.

W-798

NORTON ABRASIVES

ON THE COVER

OURO PRETO, Brazil, was once a thriving gold-mining camp, so much so, in fact, that 52 churches were built there. When gold mining declined, many of the residents moved elsewhere, and the town dwindled to a fraction of its former population. The churches, however, have been preserved and maintained as national monuments by the Brazilian Government. They are of Portuguese architecture. The name Ouro Preto means "black gold," and was given to the camp because the gold produced there was of an unusually dark color.

•

IN THIS ISSUE

TO MANY persons, a savory cup of coffee is one of life's necessities, and even those who are kept awake by caffeine can enjoy the beverage without suffering any ill effects—thanks to a special treatment that removes the offending substance from the beans. Our grandmothers roasted the beans and ground them fresh for each pot, so the brew was often unusually good. Scientists have found a way to pack ground coffee so that it stays fresh for a long time; and recently they have also improved the roasting technique. Processing practices in the world's largest coffee-treating plant are described in our leading article.

•

THE iron mines of the eastern seaboard are booming again. In New Jersey, New York, and eastern Pennsylvania, underground workings hoary with age are producing magnetite and competing successfully with the open-pit hematite mines of the Great Lakes ranges. Among the active properties is the Mount Hope Mine, which is reputed to be the oldest iron producer in operation in the country.

•

THE streams that flow through the Pennsylvania anthracite region seemingly carry black water; but close inspection reveals that their bottoms are covered with fine coal washed down from the culm and silt banks and the breakers at the collieries. Dredging of these deposits constitutes a sizable industry, as is told in *River Coal*.

•

A tunnel is underway in Colorado that will, it is said, be the longest ever driven from two portals without intermediate shafts or adits. It is the 13.1-mile Continental Divide Tunnel that will divert western-slope water to eastern-slope farms. A description of the work now in progress at the east end starts on page 6391.

Compressed Air Magazine

Copyright 1941 by Compressed Air Magazine Company

Volume 46 **MARCH, 1941** **Number 3**

C. H. VIVIAN, *Editor* J. W. YOUNG, *Advertising Manager*
A. M. HOFFMANN, *Assistant Editor* J. F. KENNEY, *Business Manager*
D. Y. MARSHALL, *European Correspondent*, 243 Upper Thames St., London, E.C.4.
F. A. McLEAN, *Canadian Correspondent*, New Birks Bldg., Montreal, Quebec.

EDITORIAL CONTENTS

Let's Have a Cup of Coffee—*Robert G. Skerrett* 6375
New Jersey Magnetite—*C. H. Vivian* 6380
River Coal—*L. A. Luttringer, Jr.*, ... 6387
Continental Divide Tunnel—*Allen S. Park* 6391
Eimco Tunneloader 6395
Adaptable Plugs for Stemming Drill Holes 6395
Texas Holds Highway Week 6396
Air-Enveloped Lights 6396
Lubricating Heavy Equipment on the Job 6396
Editorials—Deep Nonmetallic Mines—Grand Coulee Dam—Floating Power Plants 6397
Feats and Facts 6398
Industrial Notes 6399

ADVERTISING INDEX

Allis-Chalmers Co. 26-27
Bethlehem-Steel Co. 20
Bucyrus-Erie Co. 15
Carborundum Co., The 11
Conrader Co., R. 25
Coppus Engineering Corp. ..... 2d Cover
Crane Packing Co. 19
Eimco Corp., The 6-7
General Electric Co. 12
Goodrich Company, The B.F. 17
Hanna Engineering Works 31
Hercules Powder Co., Inc. 32
Industrial Clutch Co. 10
Ingersoll-Rand Co. 4-21-22-28-29
Jarecki Manufacturing Co. 31
Lewyt Metal Products Co., Inc. 24
Logansport Machine, Inc. 24
Lovejoy Flexible Coupling Co. 30
Manhattan Rubber Mfg. Div., The 31
Maxim Silencer Co. 25
National Forge and Ordnance Co. 25
Naylor Pipe Co. 23
New Jersey Meter Co. 30
Norton Company 16
Socony-Vacuum Oil Co., Inc. 8-9
Square D Company 25
Staynew Filter Corp. 3
Taylor-Wharton Iron & Steel Co. 13-14
Texas Company, The 5
Timken Roller Bearing Co., The ..... 4th Cover
Toledo Pipe Threading Machine Co. The 23
Vogt Machine Co., Inc., Henry 18
Waukesha Motor Co. ..... 3rd Cover
Willson Products, Inc. 23
Wisconsin Motor Corp. 24

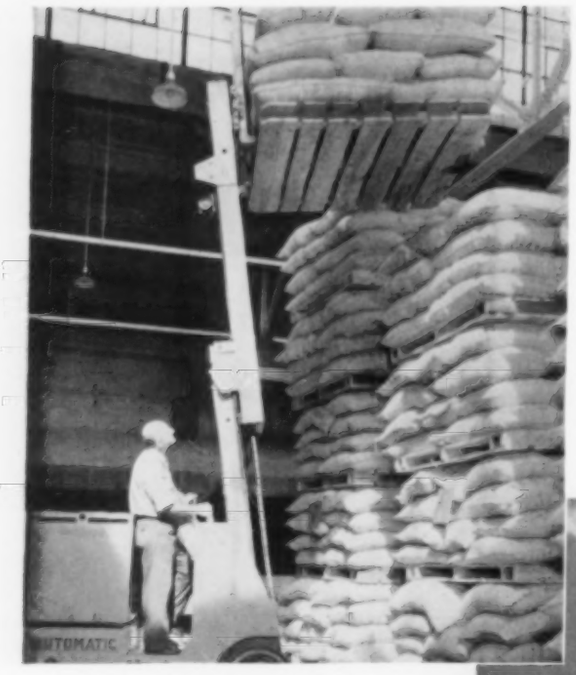
A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit.

Published by Compressed Air Magazine Company. G. W. MORRISON, president; J. F. KENNEY, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y., L. H. GEYER, representative.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

Let's Have a Cup of Coffee

Robert G. Skerrett



All photos by Schnall, New York

WORLD'S LARGEST COFFEE-PROCESSING PLANT

Ships bringing thousands of bags of green coffee from below the equator tie up at the pier of the Maxwell House Coffee plant in Hoboken, N.J., and discharge their cargoes, as pictured at the right. At the left is a corner of the storehouse where the coffee is kept awaiting processing. The telescoping, tilting truck shown can handle a 2-ton load at one time.

GENERAL Foods Corporation now has in full swing on the waterfront of Hoboken, N.J., what is said to be the world's largest and most modern plant for processing coffee. That group of impressive structures, occupying a 9-acre tract, may fittingly be looked upon as a monument to the late Joel Owsley Cheek, because his genius and persistence gave us Maxwell House Coffee—first placed on the market in a small way back in the early "eighties." The Hoboken plant is capable of handling, blending, roasting, grinding, and packaging 300 tons of coffee in a 2-shift working day—or enough every 60 minutes to make the equivalent of 1,500,000 cups of the popular beverage. To evaluate what is now done there, one should know something about Joel Cheek and the years he spent in quest of a blend that would give the world a better cup of coffee than was then obtainable.

Joel Cheek was born and reared on a Kentucky farm. When he came of age, in 1873, he journeyed to Nashville, Tenn., bent upon making for himself a more promising order of life. In the Tennessee capital he got a job with a wholesale grocery house; and for some years traveled the mountainous countryside on horseback, with saddlebags filled with samples, seeking customers for his wares. Curiously, none of the coffees Cheek had for sale satisfied his own exacting taste; and in his off hours he mixed, roasted, and made in small quantities infusions that would tickle his palate. What he sought long eluded him; but at last he found the secret of what he afterwards described as "the perfect blend of matchless flavor."

Joel Cheek next became a coffee blender and roaster in Nashville, and soon submitted his product to the management of the Maxwell House in that city. That old hostelry was both a social and political gathering place, and was noted for its fine cooking, excellent service, and hospitality. His blend soon found favor with the discriminating patrons, and it was not long before the management elected to use it exclusively. Because of that recognition it was called Maxwell House Coffee. In time, the demand increased to such an extent that the Cheek-Neal Coffee Company—as the enterprise was later known—not only had a good-sized place in Nashville but plants also in Houston, Tex., Jacksonville, Fla., Brooklyn, N.Y., and Los Angeles, Cal. In 1928 it was merged with what is now the General Foods Corporation. Since then an establishment has been built in Montreal, Canada, and still later one in Hoboken. President Theodore Roosevelt once described Maxwell House Coffee in his characteristically vigorous way as "Good to the last drop"! Sales today would seem to confirm that approval of 30-odd years ago.

The coffee tree flourishes in the tropics; and the coffees that reach us from many parts of the world differ as widely as the regions in which they are grown. Some are mild flavored, others pungent; some are deliciously aromatic and others much less so; and those from one place may be sweet while those from another may be decidedly bitter. It is only by roasting the beans that those qualities are revealed that are familiar to us; but it takes an experienced coffee taster, as a rule, to

identify the source of a coffee and to evaluate the various unmixed kinds so as to produce a blend that will win favor.

For testing, the taster carefully roasts a small batch of beans in a little roaster. When properly colored he grinds the coffee, places just enough of it in a cup to counterbalance the weight of a 5-cent piece, and pours boiling water on it. The infusion is first judged by its aroma, and then a spoonful is drawn into the mouth and held there to appraise its appeal to the palate—the liquid is not swallowed. It is in this way that the coffees for a given blend are chosen and their proportions prescribed. Please note that the taster has his coffees directly from the roaster and that he tests them when their fragrance and their flavor are richest.

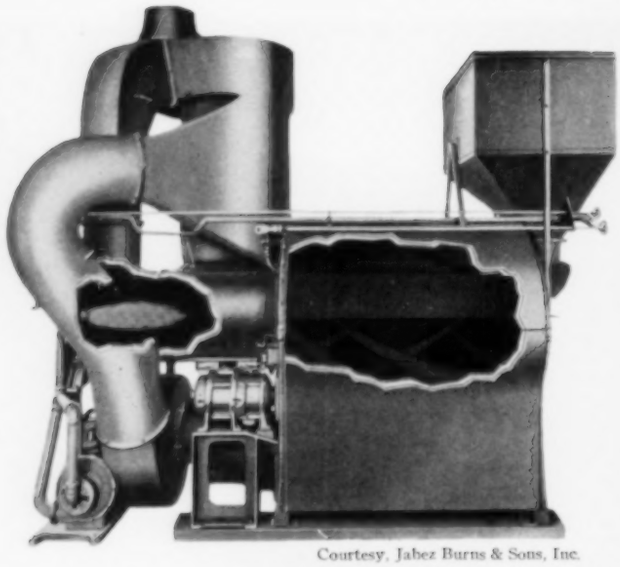
Some decades back, the housewife or the cook often used the stony and seemingly unpromising beans of green coffee then widely marketed and roasted them herself, stirring them continually to guard against scorching. The beverage from the freshly roasted beans was generally good—often surpassingly good. That was because the aroma and flavor developed by the roasting were caught and held by the infusion before the free air could carry them off or change them. To give its patrons coffee of this nature, General Foods does this work at its Hoboken plant in the latest of scientifically perfected roasters and packs the product in vacuum-processed containers by the Vita-Fresh method.

The plant is situated at the waterside in the Port of New York where ships from coffee-producing countries can tie up at a pier 522 feet long and 60 feet wide. They discharge their cargoes into a long shed that connects with a storehouse large enough to hold 7,000 tons of green coffee in bags each weighing from 132 to 150 pounds. The storehouse adjoins a 6-story building in which Maxwell House Coffee is processed and packed. Nearby, in a 4-story structure, caffeine is extracted from green beans for Sanka and Kaffee coffees for people that are inclined to wakefulness after drinking untreated coffee in the evening. How the caffeine is removed and put to other worth-while uses is a story in itself.

Alongside the Extraction Building is the power house in which are two Babcock & Wilcox boilers designed for an operating pressure of 400 pounds and with a maximum capacity of 35,000 pounds of steam per hour. Each is fitted with three independent steam-mechanical, atomizing oil burners that are fitted with compressed-air controls. One, two, or three burners are used on boilers at a time, depending upon the demand load. At one corner of the property there is a 3-story structure of special design that houses the local administrative headquarters and the Central Laboratories of General Foods. The work done in the latter affects the activities in all the plants owned and operated by the corporation.

A compressor in the boiler room delivers, to a nearby receiver, air at 50 pounds pressure that performs various services throughout the establishment. It is used at the burners of the two boilers as a medium of control, as well as for control purposes in the Extraction Building, and it is extensively employed in cleaning the coffee-packing equipment and associate mechanical features in the Processing Building. The fire-protection sprinkler feed lines are charged with compressed air, which escapes when a sprinkler fuse is melted by the heat, permitting the water to flow freely and to do its quenching work. The staff of the Central Laboratories has compressed air at its disposal and applies it in a number of helpful ways. The object in using compressed air and vacuum in the great Hoboken plant is to minimize manual work, to save mechanical power where possible, and to have each succeeding operation in the cycle so nicely coördinated that not even the least fraction of ordered time shall be lost. These factors contribute to economy of production and regulate largely the price we pay for the coffee.

The bags of coffee are moved from the



Courtesy, Jabez Burns & Sons, Inc.

BLENDING AND ROASTING

Tasters determine the blend to be used, and the green beans are brought together in the proportions specified and thoroughly mixed in revolving drums, one of which is seen at the lower right. Roasting is done in Thermalo machines, the principle of which is shown in the cutaway view. In the combustion chamber, which is at the left of the unit, are heated inert gases that pass into the revolving perforated cylinder at the right. There the coffee is roasted at a relatively low temperature while being tumbled continuously. At intervals, a skilled attendant (left), peers into the cylinder to observe the gradual change in color of the beans, a deep brown marking the completion of the roast. The usual roasting period is about twenty minutes.

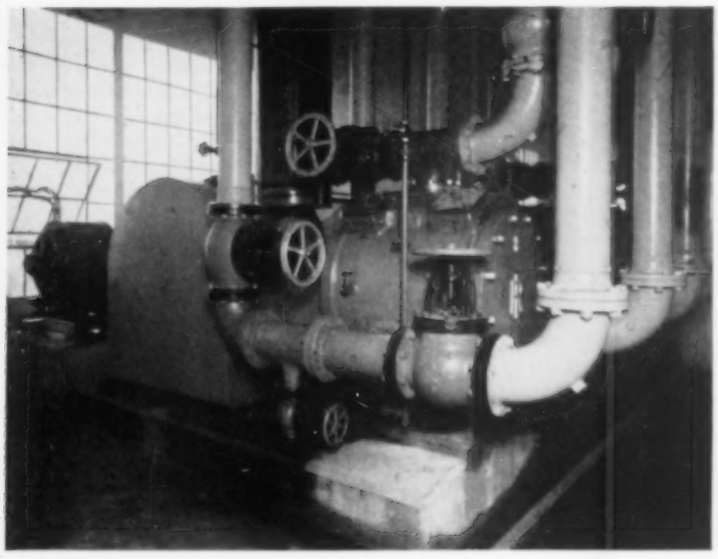
pier into the storehouse and are stacked there by automatic-tilting, telescoping-tiering electric fork trucks each of which can lift, transport, and place at a time a load of bags weighing more than a ton. Once under cover, the green coffee may be held a year or more awaiting processing, for it has been found that aging greatly improves the quality of coffee at the time of roasting. Each shipment from a given source is tested by the coffee tasters who decide how much of each kind shall go into the desired blend. Then, at the proper time, so many bags of each are raised to the sixth floor of the Processing Building to flow, mostly by gravity, through the various stages that follow in treating the coffee, packing it, and finally landing the filled and sealed cartons on the shipping floor convenient for loading into freight cars or motor trucks for distribution.

The first step consists in dumping the bags of green coffee of the chosen varieties into a cleaner which removes all foreign matter that is lighter than the beans—such as bits of string, lint, grit, hulls, small sticks, etc. Streams of air do the trick, and carry the trash away to a sealed container. The cleaned coffee is then raised by a bucket elevator to a bin which, in turn, feeds the beans to a mixer —a large revolving, horizontal cylinder that thoroughly blends the coffees for a large batch in the course of about five minutes. While this is going on, streams of air, drawn through the cylinder, pick up any dust and light particles loosened from the tumbling beans and sweep them to cyclone collectors at the top of the building.

From the mixer, the now thoroughly blended coffee is dropped into a dump bin from which it is lifted by a bucket elevator to chutes that deliver it to a hopper at and above the front end of each roaster. Now we come to the machine by which the green beans are transformed from virtually odorless and tasteless bodies into aromatic, flavorful ones uniformly roasted inside and out. These, when made into a steaming beverage, will yield the utmost of their natural richness. The theory and practice of coffee roasting have changed in some essential particulars in the last few years. As a consequence, we now get a better cup of coffee day in and day out than was formerly possible, except by chance.

The coffee bean is a complex composite of such substances as water, fat, wax, sucrose, caffeic acid, cellulose, protein, etc., held together largely in an inert state until subjected to roasting, which brings about a train of physical and chemical changes that are more or less radical in their nature and extent. About six years ago, a group of technicists in Hoboken set about discovering the most effective way to apply heat in roasting coffee so as to make the most of the delectable properties stored in the green beans. Research disclosed that much lower temperatures than were then used could be employed to advantage. One of the investigators, Prof. L.H. Backer, published an account of the work, and in summing up what they had achieved, he made this revelation: "Our three years of experimenting, testing and analyzing were rewarded, inasmuch as, by this method of low-temperature heat transfer, we had developed a roasting method which requires little or no skill on the part of the operator, is under perfect and automatic control, is most economical, and delivers a definitely superior product."

With that information, and with a designing and manufacturing experience reaching back to 1864, Jabez Burns & Sons, Inc., the firm responsible for the roasters in the Hoboken plant, developed what is now known as the Thermalo machine. The method of applying the heat produces coffee that has the same color inside and out, and all the beans of a given



VACUUM PACKING

The girl at the left is replenishing the supply of covers that are placed on the cans of coffee after virtually all the air has been exhausted from them in the 5-chamber closing machine to her left. In the latter, vacuum is applied in three stages, reaching 29.75 inches in the final one during which the tops are crimped on. Each can is then "locked out" to atmospheric pressure in reverse order. In the first two stages, vacuum up to 28.5 inches is developed by four Ingersoll-Rand Class ER 2-stage vacuum pumps, two of which are shown above. Each of these units has a piston displacement of 594 cfm. and is belt driven by a 30-hp. motor.

batch are identical in this particular. There are no superficial scorched spots—the beans are smooth, highly polished, and devoid of cracks which, in the case of some roasters, are filled with the soot of burned chaff that imparts a smoky taste to the beverage. Finally, the degree of heat used, while ample perfectly to roast the coffee, does not decompose the waxy surface fats nor break down the oils in the beans, both of which contribute so much to the fragrance and to the flavor of a cup of coffee.

At its rear end, a Thermalo roaster has a burner that is fed with fuel oil at high pressure and that is supplied with compressed air to aid in atomizing the oil and to promote and to regulate combustion at the heating flame. The latter projects into a combustion chamber through which is blown at high velocity a steady stream of inert gases that passes onward and into a perforated revolving cylinder where the coffee beans are roasted. The heat from the somewhat removed burner is transferred by convection and penetrates by conduction into the heart of every bean exposed to it. The gaseous flow continues outward through the perforated shell of the cylinder, carrying along with it any chaff or fiber detached from the beans. After passing through a separator, the gases of combustion are picked up by a recirculating fan and blown back into the heating chamber to retrace what is virtually a closed circuit. The temperature in the roasting cylinder is not high enough to burn any chaff even if it were not removed.

The use of convection and conduction prior to the development of the Thermalo roaster was not a success, and mainly because every coffee bean is surrounded by an extremely thin film of gas that tends to act as an insulator. In that respect the film will retard conduction quite as effectually as a copper envelope 16,000 times as thick! This barrier to heat transfer is now neutralized by the combined action of the stream of heated gases and the tumbling of the beans by the blades of the revolving cylinder.

Each roaster holds approximately 1,000 pounds of green beans; and the roasting time is twenty minutes, which is standard practice. Roasting expands the bean, and makes it nearly 50 per cent lighter in proportion to its volume than it was before. Each Thermalo is equipped with automatic signals that notify the attendant when the process is nearing completion; and a window in the front end permits the operator to see into the cylinder which is illuminated so that he can, night or day, properly judge the color of the roast, which is the determining factor. Air for the burners is supplied at a pressure of about 8 pounds by a group of rotary compressors. All told, there are six lines of roasters, in each of which there are from three to four units.

As the charge of each roaster reaches the finished stage, the smoking-hot batch is discharged into a circular steel container—not unlike some types of laundry wringers—in which there are a number of horizontally revolving arms with vertical sweeps that stir the coffee without cease so that it may be uniformly cooled in less than twenty minutes. This operation is an important one. Currents of fresh air are drawn through the coffee during the cooling period, and these sweep through every layer of the batch and thus reduce the temperature throughout to the desired degree for the next processing stage.

From the cooler, the coffee goes into a bin that feeds it into a self-regulating "stoner," where stones, nails, and any other materials heavier than the beans drop away and the lighter coffee grains are lifted by a strong movement of air into a storage bin from which, still warm, they are delivered by gravity flow to granulizers that grind the coffee into the three grades now marketed. As a final precaution against tacks and other small pieces of iron and steel there is, just above each granulizer, a magnetic separator that keeps such foreign bodies from getting into those precisely built machines. From the granulizers the coffee descends to the respective bins, on the floor below, that transmit it to the filling machines that automatically put the prescribed amount in each tin can. It is fed from True-Flow Bins which keep the granules thoroughly mixed so that there is no variation as the cans are successively filled. This is essential, because people buy ground coffee for use in a percolator or in a drip or other type of coffee maker.

The cans reach the filling department by straight-line, gravity-flow, overhead runways; but just before arriving at a filler, each can traces a somewhat winding and descending course and turns over

completely to spill out anything that may have got into it. After leaving the filler it is carried on a horizontal conveyor beneath a small pivoted wheel so hung that if it drops below a prescribed level because the can is not completely filled or is empty it actuates a signal that gives warning of that fact to the proper operator. A little farther along, an attendant frequently removes a filled can at random from the conveyor and weighs the contents to make certain that the filling machine is not skimping.

The cans move to and from a filling machine at the rate of from 65 to 85 a minute, according to the quantity of coffee put in each. Beyond the checking station, the conveyor travels steadily onward to the closing machine, where the first automatic operation is that of placing a cover on each container. Then follows a succession of precisely timed and interrelated functions that close and seal each package airtight after the air inside of it has been exhausted. The latest of these closing machines, which represent the collaboration of Thomas M. Rector, manger of the General Foods Central Research Laboratories, and a group of experts of the American Can Company, make possible the Vita-Fresh process as it stands today.

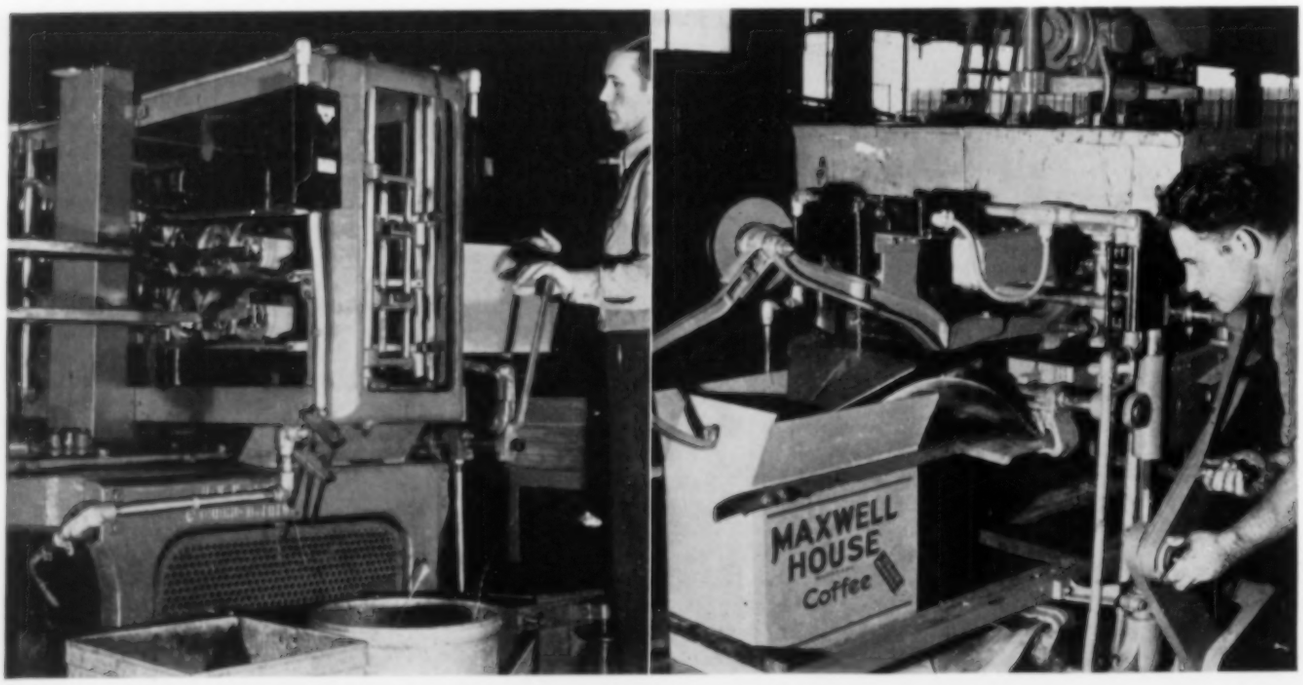
The fullness of the fragrance and flavor of newly roasted coffee soon diminishes when the beans are exposed to the air, and the rate of loss is greater in the case of ground coffee. After the freshness has thus been lessened, then the oxygen of the atmosphere brings about changes that are noticeable to the taste by staleness. Logically, the only way to protect coffee when prepared to meet the requirements of the ultimate consumer is to put it in a hermetically sealed container from which well-nigh all air has been withdrawn by vacuum pumps. The degree of this extraction determines the length of time the canned product will retain its freshness. At the Hoboken plant the interval between discharge from the roaster and sealing in a can is less than an hour.

A closing machine is somewhat too complicated to be described in any detail here. In principle, it is made up of five interconnected chambers of which the central one, with mechanical means for crimping on the cover airtight, is really the closing chamber. In the latter is maintained the highest degree of vacuum, while the two approach and two discharge chambers are under lower stages of vacuum. That is to say, the arriving can enters the first compartment from the open air, and before leaving it is under a vacuum of 23 inches. In the next one the vacuum, known as the intermediate stage, is increased to 28.5 inches, and in the closing chamber it is raised to 29.75 inches—only 0.25 inch less than the barometrically perfect vacuum of 30 inches. The stages and measures of vacuum application are reversed as the sealed can leaves the central chamber and makes its way out to the atmosphere.

Broadly stated, each can on entering the closing machine goes into an enveloping pocket on a revolving table, and at the top of that pocket connection is made with the suction of vacuum pumps. When half a circuit has been traveled in the low-vacuum chamber, the can—like a sand hog being "locked" into a working space under compressed air—is impelled into the intermediate-vacuum chamber. From there, after the application of 28.5 inches of vacuum, it is successively moved, also by the locking process, into the high-vacuum or closing chamber, the outgoing intermediate-vacuum chamber, and the associate low-vacuum chamber. At that point it is locked out and transported by a conveyor to a packing machine that automatically pushes it with just so many others into a carton and seals the latter.

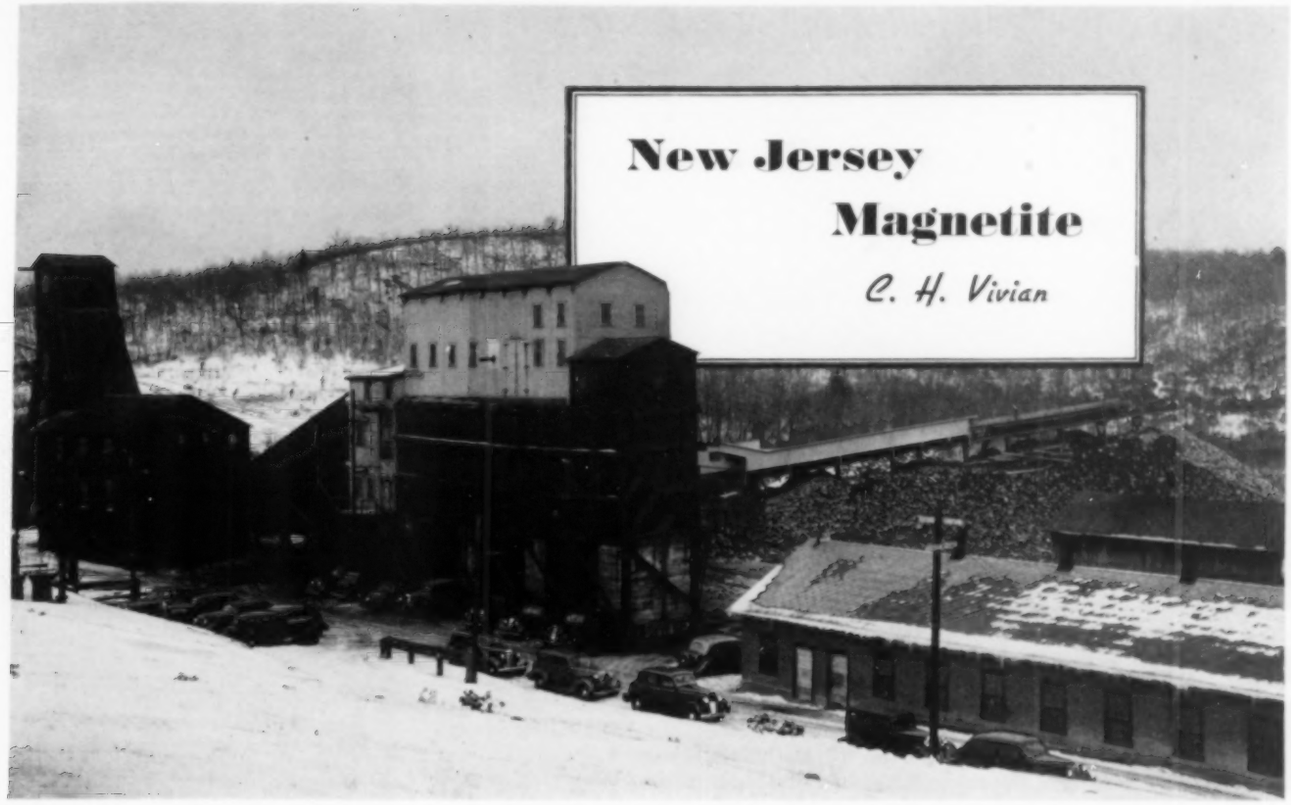
The larger share of the vacuum required is induced by four Ingersoll-Rand Class ER-2, 22x9-inch vacuum pumps, and is applied directly to the low and to the intermediate chambers, thus changing the barometric conditions from atmospheric pressure to a vacuum of 28.5 inches. These machines are on one of the upper floors of the Processing Building, and their foundations are insulated with cork to prevent the transmission of vibration to other parts of the structure. A group of smaller pumps is used to bring the vacuum up to the final stage of 29.75 inches. The two batteries are so interconnected that the suctions of the ER-2's pull the exhaust from the high-stage units and so increase the total efficiency of the pumps.

Good though it was, there is no comparison between the Maxwell House Coffee from Joel Cheek's original establishment and that from the existing plants, because it is now possible to clean, roast, grind, and pack it under conditions that will insure its freshness for months running.



PACKAGING

The machine at the left picks up six cans of coffee at a time and quickly loads a carton with the required number. A second machine, shown at the right, closes the flaps of the box and seals it for shipment.



New Jersey Magnetite

C. H. Vivian

MOUNT HOPE MINE

From left to right are the headframe, the shaft house, and the lump-ore plant with the rock dump. The long building is the change house. The office, shops, fine mill, and compressor plant lie apart from this group and are not shown.

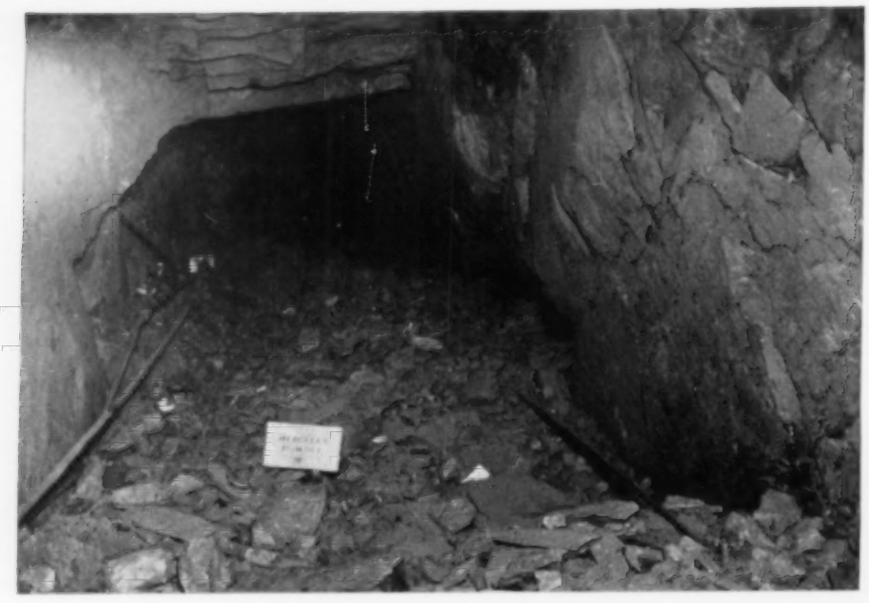
ONE ordinarily associates metal mining with the western part of the United States, but there are sizable mining operations within an hour's journey from New York City. Four iron mines and two zinc mines are being worked in New Jersey, and two iron mines are producing in New York State. All are long-established properties with impressive output records. In fact the Mount Hope Mine, an iron producer, with which this article is concerned, is claimed to be the nation's oldest mine in operation.

The Mount Hope Mine is located at Dover, N. J., only 40 miles west of New York City. It is owned and operated by the Warren Foundry & Pipe Corporation. The same concern owns the Scrub Oak Mine, near Dover, and the Washington Mine near Oxford; but both the latter properties are worked under lease by the Alan Wood Steel Company. The fourth New Jersey iron mine is the Richard in the Dover area. It is owned and operated by the Thomas Iron Company, a subsidiary of the Philadelphia & Reading Coal & Iron Company. The ore from the Richard is sold in the open market, while that from the Scrub Oak and Washington is utilized in the iron- and steel-making plants of the companies that mine it The Warren Foundry & Pipe Corporation, on the other hand, uses none of the ore it obtains from the Mount Hope Mine but sells it chiefly to steel companies in Pennsylvania.

All the New Jersey iron ore is magnetite of a grade that compares favorably with the best produced elsewhere. Magnetite, which owes its name to its magnetic properties, is the purest form of iron found in nature and contains the largest percentage of iron (72.4 per cent when pure) of any ore. Its composition is virtually the same as that of the black scale that forms when metallic iron is heated above red heat. Most of the extensive deposits of iron ore in Sweden are magnetite. Except for deposits in New Jersey, New York, eastern Pennsylvania, and the eastern end of the Mesabi range, the mineral is not known to exist in large quantities in the United States where most of the commercial ore bodies consist of hematite, a softer, nonmagnetic oxide that has a lower iron content.

Prior to the opening up of the Lake Superior ores in 1882, most of the iron ore produced in the eastern part of this country came from New Jersey. Numerous blast furnaces were established near the mines; and in 1882 New Jersey stood sixth among the states in the output of pig iron. Gradually, however, our eastern steel mills substituted Lake Superior and imported ores for those from New Jersey. This was the result partly of increased freight rates from New Jersey. By 1920 only two blast furnaces remained in the state, and the last of these was scrapped in 1933. From the World War period to 1937, the eastern steel mills obtained most of their ore supply from abroad, the importations from 1921 to 1930 having totaled 22,000,000 tons. This ore came principally from Chile, Cuba, Africa, and Sweden. For the past four years, however, New Jersey mines, as well as those in New York and eastern Pennsylvania have been operating steadily, and their outlook for the future is favorable.

New Jersey iron ores occur in a roughly rectangular area containing some 1,200 square miles and extending from the New York State line in a southwesterly direction almost to Phillipsburg on the Delaware River. The center of the area and the section where the greatest production has taken place is near Dover. The deposits are disposed in eighteen distinct parallel ranges or lines. Individual ore bodies are lath-like in shape, being long, relatively thin masses. If you were to point a lath, with its thin edge up, northeastward so that it sloped downward at an angle of 15°, and then tilted it so that its sides sloped southeastward at an angle of 55° from the horizontal, you would be duplicating the disposition of the ore bodies in the earth's crust. They are from 6 to 100 feet wide and usually about 200 feet high; have never been



STOPE AND AIR HOIST THAT SERVES IT

At the left is a stope in the North Elizabeth ore body. It has been worked almost to the full height of the deposit and its converging walls have narrowed it somewhat. The broken ore extends clear to the bottom of the stope, where it is drawn off through chutes. Access to a stope is gained at each end through a raise and connecting manway. Drills, powder, and other materials are hoisted and lowered in a skip for which the sides of ladders serve as runways. The skip is suspended by a 3/8-inch cable that is powered by an Ingersoll-Rand air-operated Utility hoist, as shown below. The picture was taken by pointing the camera directly down the raise.

mined deep enough to determine their length, although some of them have been followed for 10,000 feet along the downward slope or pitch; and lie between metamorphic rocks of pre-Cambrian age that dip as they do. In each range there are a number of deposits all in the same plane, and because of their pitch they outcrop at various points. The ore bodies are unusual because of their uniformity in shape and remarkable because of their regularity and persistence. Their thickness, inclination, and iron content as indicated at the surface continue with little variation as deep as any of them have been worked.

According to the New Jersey State Geological Survey, there are 366 magnetite deposits in the state that have been mined at some time. H. M. Roche, a consulting engineer of Dover who has examined virtually all of them, considers 90 of the ore bodies of workable size—that is, more than 6 feet wide and 200 or more feet high. He estimates that there are 604,000,000 tons of ore above the 2,500-foot level containing from 40 to 60 per cent iron. Assuming that the average iron content is 45 per cent, these reserves are capable of producing 402,666,666 tons of 67 per cent iron concentrate, or sufficient to maintain an output of 5,000,000 tons annually for 80 years. If ores of 30 to 40 per cent iron were included, the reserves would be doubled.

The earliest mining of iron ore in New Jersey of which there is record was done at Tinton Falls, in Monmouth County, in 1674. It is believed that the Mount Hope deposits were first worked about 1715. One ore body there, known as the Great Jugular Vein, outcropped in the form of a cliff 100 feet high. Until the mine was surveyed and recorded in 1749 the mineral was free to everyone. The operators backed their wagons up to the cliff, loaded them, and hauled the ore to Dover, where a forge was in operation as far back as 1722—the absence of water for power making it impossible to establish a forge at the mine. There have been many owners of the Mount Hope deposits, the Warren Foundry & Pipe Corporation having come into possession of them in 1922. During the Revolutionary War, Jacob Faesch, lessee of the property, produced cannon, cannon balls, iron kettles, and other equipment for the Continental Army.

Early mining operations leveled the cliff, and the Great Jugular Vein and other ore bodies beneath the surface were opened up by means of pits. Later on, where conditions were favorable, adits were driven into side hills to cut the deposits at lower levels. When too great a depth was attained to continue this method, shafts were sunk to the individual deposits. Since 1912, all mining at Mount Hope has been carried on through the Brown Shaft, with underground workings connecting the various producing ore bodies. The output to date amounts to about 4,000,000 tons.

The ore zone now being mined at Mount Hope is approximately 550 feet wide. At each edge of the zone are two main parallel veins. On the southeast side are the Leonard and the Elizabeth ore bodies, the latter being at the lower horizon: on the northwest side is the Taylor. The Mount Hope fault, which cuts the vein system almost at right angles, has displaced the ore bodies 380 feet vertically and 150 feet horizontally. It has prevented working the deposits continuously along their pitch and has divided the mine into what are known as the north and south workings. From the fault zone the ore bodies, because of their pitch, slope upward toward the south and downward toward the north. Southward from the fault, the deposits previously mentioned have been virtually exhausted, and practically all the present output is coming from the northern division of the mine.

The shaft, which follows the Taylor ore body downward, inclines at an angle of 68° and extends to a point 100 feet below the 1,000-foot level, which is the main haulageway. From this level, auxiliary inclines are driven beneath the ore bodies, those toward the north sloping downward and those toward the south sloping upward. They are 8x10 feet in cross section and are untimbered. Ore is delivered to these inclined haulageways from the overhead stopes by chutes, and is then hoisted or lowered by way of the inclines to the 1,000-foot level, transferred to cars, hauled to the Brown Shaft, and raised to the surface. There were four active inclines during 1940, three of which extended northward and one southward. The longest of these is the 2,881-foot North Taylor, which attains a depth of more than 1,700 feet below the shaft collar. Because of its length, hoisting through it must be done in two stages, there being a lower hoist of 75 hp. and an upper one of 200 hp. Ore from the lower part of the Taylor ore body must therefore be transferred four times before it

reaches the surface. The North Leonard incline is 2,288 feet long and is equipped with a 100-hp. hoist; the North Elizabeth incline is 1,660 feet long and has a 100-hp. hoist; and the South Elizabeth incline is about 1,300 feet long and is equipped with a 75-hp. hoist.

In the inclines, hoisting is done with 4-ton skips running on 48-inch-gauge track made up of 60-pound rails: on the main haulageway, ore is transported to the shaft in 4½-ton Granby-type cars that are made in the mine shops. The cars are equipped with Timken roller bearings and weigh more than 3 tons each. Trains are made up of seven cars each and are drawn by Westinghouse trolley locomotives using 250-volt direct current. There are four of these locomotives. The average haulage distance to the shaft is 1,500 feet, and the maximum is 3,750 feet. At the shaft bottom the ore is dumped through a grizzly with 10-inch openings into a loading pocket. Pieces too large to pass through the grizzly are blockholed and shot.

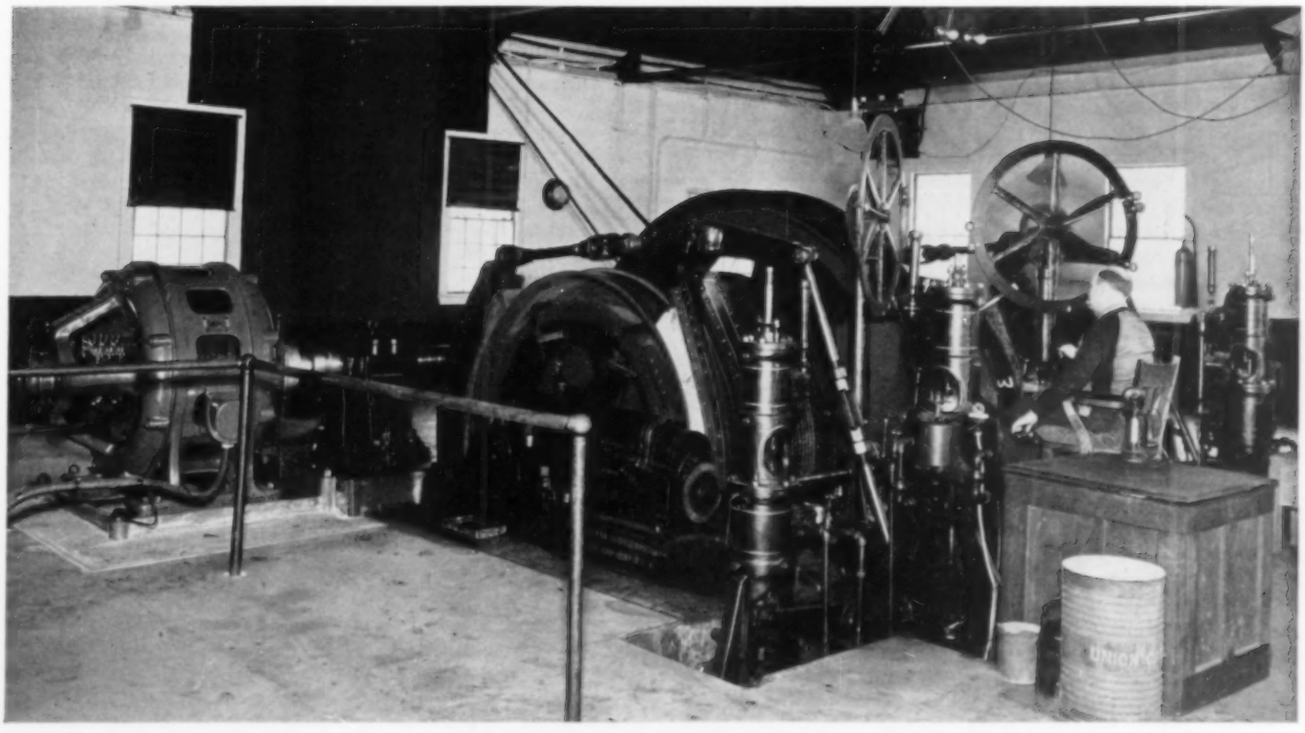
At the present time, the North Taylor incline is being extended 310 feet, and this will permit opening up a new stope above it. Drilling is being done with two Ingersoll-Rand DA-35 drifters. The muck is drawn up the incline by an I-R Size 20 NM-3F double-drum electric slusher hoist and dumped into a skip resting in a pocket that was formed by driving the first section of the incline on a slope of 25° instead of the 15° slope that is being followed throughout the remaining distance.

During 1940, a drift that leads southward from the shaft crosscut on the 1,000-foot level was advanced 2,820 feet. This was done for the purpose of opening up the Teabo ore body. The drift did not intersect the Teabo; but diamond drilling from the end of it located the deposit and revealed a width of about 15 feet of 50 per cent ore. It will be developed by the usual method of driving an incline under it; and the 75-hp. hoist now in the incline serving the almost depleted South Elizabeth ore body will be moved to that location.

The Teabo drift is 11 feet wide at the bottom, 10 feet wide at the top, and 8½ feet high. Drilling was done by three men with two DA-35 drifters mounted on columns and bars. A round consisted of 29 to 31 holes 9 feet deep. They were loaded with Hercules No. 2 (1½x8 and 1¼x8) Gelex, and an average advance of 8½ feet per round was made. Muck was removed during a second shift, at first by hand shoveling and later by a No. 21 Eimco-Finlay air-operated loader. This change resulted in reducing the mucking and tramming time from 7 hours to 3 hours. The excavated material was trammed a distance of 3,000 feet in 4½-ton Granby cars, a round usually producing some sixteen carloads.

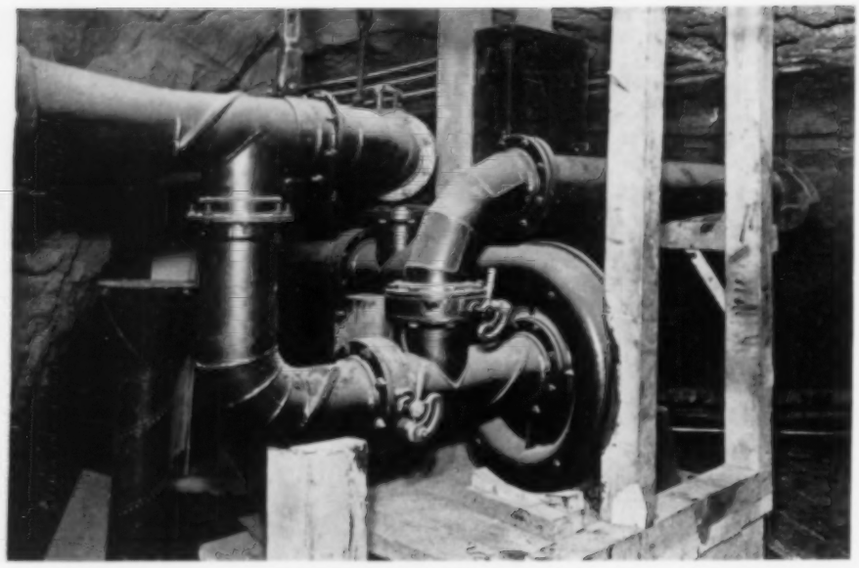
The driving of this dead-end drift called for artificial ventilation, the first to be used in the mine. There is good natural circulation elsewhere, the air coming in through old workings extending from the surface and rising through the Brown Shaft. The air is supplied by an Ingersoll-Rand Type CS single-stage Motorblower and conveyed through 4,000 feet of 12-inch-diameter Naylor Lockseam Spiralweld pipe. The blower is piped into a reversing manifold with four blast gates so that it can either blow or exhaust. In excavating the drift, the miners normally finished drilling and firing a round about 9:30 p.m. The blower was then run for about 1½ hours to remove the gases from the heading. The mucking crew came on the following morning, at which time the air was exhausted and fresh air blown in, each for a brief period. With that done the blower was shut down until night.

Mining at Mount Hope is done by means of shrinkage stopes. A stope is opened at the bottom, and the ore is broken progressively upward, being permitted to accumulate until the stope is completed. As a ton of ore that occupies 8 to 10 cubic feet in place will take up 13 to 15 cubic feet when shattered, about 5 cubic feet from each ton is removed as the stope advances, thus keeping the level of broken ore at a height from which the



MAIN HOIST

The Brown Shaft is a 3-compartment incline—two skip compartments and one for ladders, pipes, cables, etc.—1,100 feet deep and having a cross section of 16x6 feet in the clear. The first 75 feet is concreted and the remainder timbered. In some places it cuts through old stopes. Balanced skips, holding 3 tons each, are handled by means of the Wellman-Seaver-Morgan double-drum hoist shown here. Brakes and clutches on the hoist are operated with compressed air. This is ordinarily taken from the distribution lines; but on Sundays, and at other times when the large compressors are not running, it is supplied by a small I-R machine that is installed in the basement of the hoist house. The hoist has a maximum rope speed of 1,000 feet a minute.



FOR VENTILATION

With the exception of a dead-end drift, that was recently extended to a length of 4,000 feet in a successful search for a new ore body, the mine receives an ample supply of fresh air through natural circulation. The drift is ventilated by the Ingersoll-Rand Motorblower shown here. It has a rated capacity of 1,410 cfm. at 1 pound pressure. The piping and manifold arrangement is such that the unit can be used either as a blower or an exhauster. The air is conveyed through 4,000 feet of 12-inch, No. 14 gauge Naylor Lockseam Spiralweld pipe that is made up of 30-foot sections.

drillers can work conveniently. This 5 cubic feet, or roughly 40 per cent, represents the production from the stope until it is filled with ore, after which the latter can all be withdrawn.

Stopes are generally about 210 feet long, with 30-foot pillars of ore between them. They are as wide as the ore body, varying from 6 to 35 feet and averaging 15 feet. They are carried to the full height of the deposit, which seldom exceeds 200 feet. The first step in opening a stope is to drive a series of 5x6-foot chute raises upward from the incline in the footwall beneath the ore body, these raises being spaced 50 feet apart. From a point well above the incline rails two branches are then driven in opposite directions in the form of a "V" until they intersect those from the adjacent chute raises. The height at which the branches take off from the latter and the respective angles at which they are drilled depend upon the relative positions of the incline and the ore body. In the case of the Elizabeth vein they begin about 14 feet above the rails, with one at an angle of approximately 45° and the other at about 50°. In the Taylor and Leonard ore bodies, where grizzlies are required, the branches start considerably higher up.

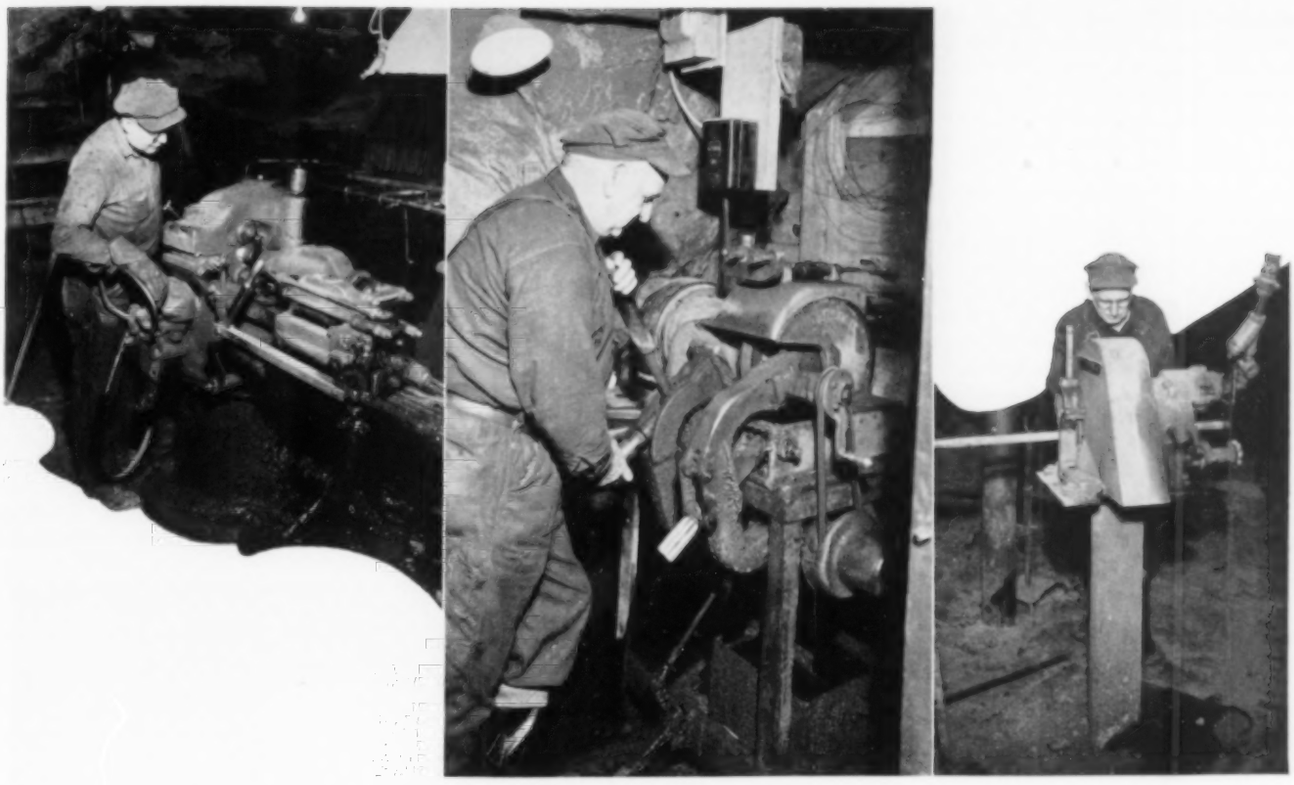
Each grizzly is 8x12 feet in size, and is placed directly over the chute in a chamber excavated for it just above the point of the "V." It is constructed of 120-pound rails laid upside down crosswise of the opening and spaced 11 inches apart. The rails are supported at their ends by 12x12-inch timbers 13½ feet long, the timber nearest the grizzly crosscut being 6 inches lower than the other. This gives the grizzly sufficient slope to make it more or less self-clearing, the finer muck passing through and the oversize pieces sliding toward the crosscut, where they are blockholed with a Jackhamer. Low-angle approaches lessen the danger of damage to the grizzly by surges of muck. Ore for tramming is thus withdrawn from the stopes, each chute being fitted at its lower end with an arc gate that opens downward. Some of these gates are operated by means of compressed air.

Access to a stope is gained through openings made in the pillars at each end before mining is started. A manway, 4x6 feet in section, is carried up through the center of each 30-foot pillar to the top of the ore body, and a working raise, of the same size as the manway and parallel to it, is driven immediately next to the pillar. Two such raises on opposite sides of a pillar are then connected at mid-height and at the top by short drifts. To reach their working places when mining is underway, the men ascend the manway raise to the midpoint or to the top, depending upon the amount of broken ore in the stope; cross through the connecting drift to the working raise; and descend into the stope. Drill steel and supplies are hoisted up the manway and lowered down the raise in a small wooden skip for which the sides of the ladders serve as runways. It is suspended on a ⅜-inch rope and is powered by an air-operated Ingersoll-Rand Utility hoist stationed in whichever connecting drift is being used.

The present system of drilling in the stopes is very effective and economical and is a big improvement over the method previously employed. The drills used are of the type known as stopers. They consist of a self-rotating Jackhamer to the

DRAINAGE PUMP

The volume of water in the mine varies with the seasonal rainfall, and the greater part of it is caught on the 400-foot level. Last year the inflow on the 1,000 level, representing the quantity collected there and that pumped up from the inclines below it, was 74.38 gpm. It is delivered to a 200,000-gallon sump and pumped from it to the 400 level, from which it is raised to the surface. The picture shows an Ingersoll-Rand Class 3GT centrifugal pump on the 1,000 level. It is rated at 400 gpm. against a head of 490 feet and is driven at 3,450 rpm. by a Westinghouse 10-hp. motor. Last year, the volume pumped from the 400 level was approximately 136,000,000 gallons, or an average of 259.43 gpm.



BLACKSMITH SHOP

A feature of the Mt. Hope Mine is its underground blacksmith shop located adjacent to the shaft on the 1,000-foot level and in a chamber that was purposely blasted out for it. With only 2 compartments in the shaft available for skip hoisting, everything possible is done to reduce the volume of materials and supplies passing through them. Moreover, an inclined shaft does not lend itself conveniently to handling long articles such as drill steel. Accordingly, the placing of the shop underground was an important step towards economy and has relieved congestion in the shaft. A further reduction in the quantity of drill steel to be transported has been brought about through the adoption of Jackbits for all drilling in the stopes. The shop is equipped with two Ingersoll-Rand sharpeners, one of which is shown at the left, an oil furnace, a Size 500 combination drill-steel cutter and shank grinder (right), quenching tanks, etc. Approximately 400 pieces of steel are reconditioned daily, including ⅞- and 1-inch hollow hexagon sections for Jackhamers and stopers and 1¼-inch hollow round sections for drifter drills. The sharpeners are provided with dies for forging threads and shanks on the Jackrods. Outside of the blacksmith shop is a J3 Jackbit grinder (center) for reconditioning the Jackbits. New bits are all of 2⅛-inch gauge and are reground from five to six times before being discarded. About 250 bits are resharpened daily.

back end of which is attached a compressed-air cylinder or leg that is designed to keep the machine against the rock face. Nearly flat or horizontal holes, rarely steeper than 30°, are drilled, the stoper being held in the desired position by means of a special set-up. This consists merely of a 2x10-inch plank one end of which rests on the broken ore in the stope and the other end on a rung of a short ladder that stands up against the working face. The rear end of the plank is firmly braced with lumps of ore. The drill is laid on this plank, the Airleg being held where desired by slipping the ring of a ringbolt over it and inserting the bolt end in a hole in the center of the plank. There is a row of these holes, 12 inches apart, so that the stoper can be advanced or retracted by shifting the bolt. The Airleg provides a feed of about 2 feet, and when withdrawn its full length, the air is released, the extension leg pushed in, and the ringbolt moved to the next hole toward the face. This is continued until a longer steel is needed. Drilling is done with Jackbits on Jackrods in lengths that permit changing steel with every 2 feet of advance, if desired. Starting bits are of 2⅛-inch diameter, and are reground four or five times to produce the succession of smaller sizes required.

Where conditions are favorable, a drill is used at each end of a stope and is run by two men who do their own blasting and air-piping work. The two crews move toward each other, breaking down a 10-foot-high slice or bench the full length and width of the stope. In a stope 15 feet wide, one row of four holes is generally drilled from 12 to 14 feet deep; but when shot, they usually bring down ore for a distance of 2 to 4 feet beyond their bottoms. Blasting is done with Hercules No. 2 Gelex in 1½x8-inch sticks. A great deal of "wooden" powder is used and consists of square sticks of wood the same length as the powder cartridges. Two or three of the latter are usually put in a hole, and then wood and powder are alternated to the collar. These "wooden" sticks serve elsewhere in the mine in raises and drifts, the total monthly consumption being about 6,000. They are made up by the mine carpenters and cost ⅛ cent each. This drilling technique has resulted in an increase of ore broken per man per shift from 12-15 to nearly 100 tons It also has cut down the number of accidents, because drillers are always in a comparatively safe place and never underneath the ore being drilled, as was formerly the case when overhead drilling was being done with stopers set up on top of the broken ore. Operations are generally going on in five stopes at a time.

Prior to 1937, all magnetite mined in New Jersey was crushed and then concentrated by magnetic processes. Now, however, the Mount Hope property is primarily a lump-ore mine, the management having developed a magnetic separating plant for handling the greater proportion of the ore just as it is hoisted. This was the first of its kind in the country, although similar ones have since been set up elsewhere. In 1940, the mine produced 193,831 tons of crude ore in 304 working days, an average of about 637 tons a day. Of this total 121,835 tons was treated in the lump-ore mill and 71,996 tons in the fine mill. Of the lump material treated, 89,854 tons was classified as ore and the re-

mainder, 31,981 tons, went to the rock pile. From the 71,996 tons sent to the fine mill, there were obtained 43,283 tons of concentrates and 28,673 tons of tailings, with 40 tons of material not being milled. The aggregate tonnage of lump ore and concentrates produced was 133,137, or approximately 69 per cent of the total crude ore hoisted.

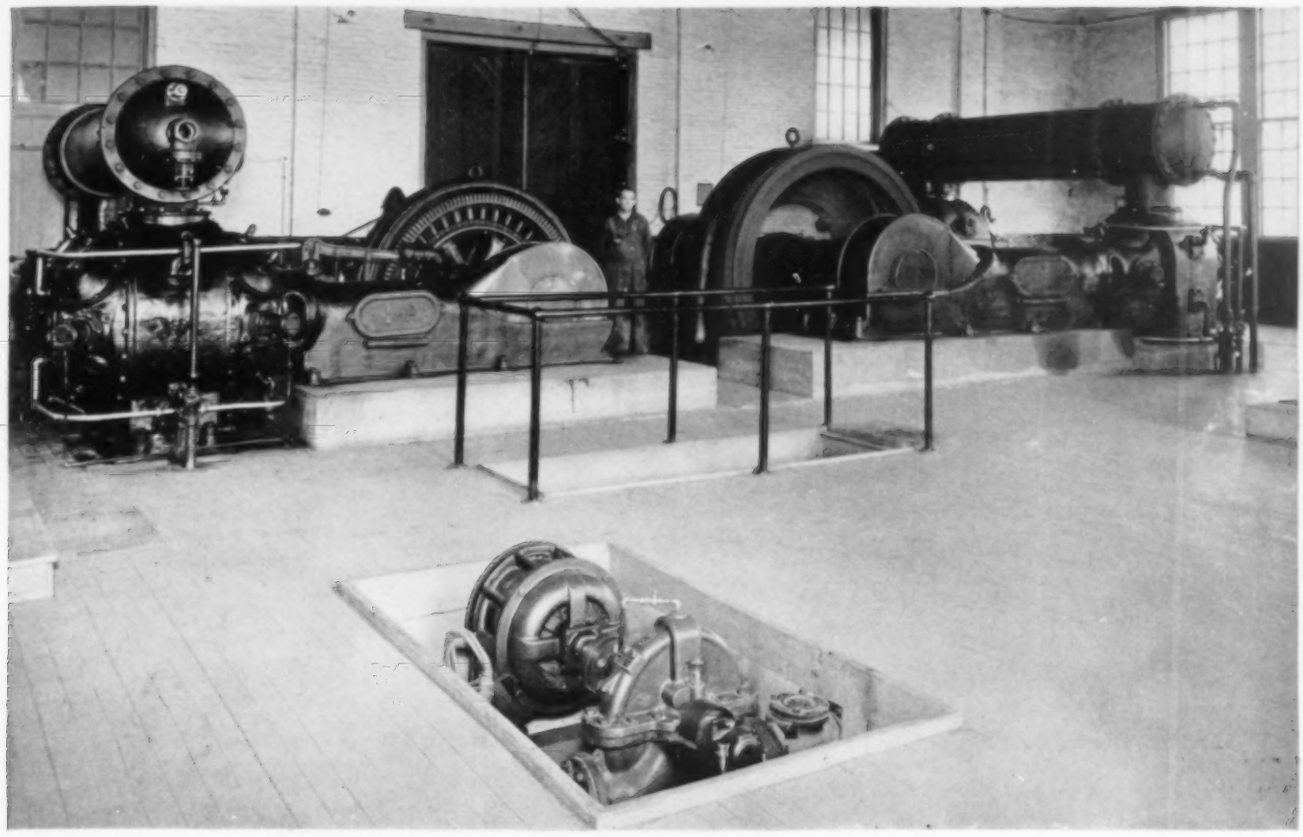
The lump ore averaged 62.33 per cent iron and 0.57 per cent phosphorus; the concentrate averaged 65.92 per cent iron and 0.246 phosphorus; and the tailings from the fine mill had an average content of 6.62 per cent iron. Substantially all the lump ore was sold to eastern steel mills for use in open-hearth furnaces, the present demand for this purpose exceeding the supply. The concentrates went mostly to steel-mill blast furnaces. As evidence of the increased consumption by reason of the industrial revival of the past year, it may be cited that the stock pile of concentrates at the mill was reduced during 1940 from around 70,000 tons to about 16,000. An unusual use was found for a specially sized concentrate during last year—approximately 500 tons were sold to water purification plants for service in filtration beds. In addition to its hardness and durability, the magnetite can be raised and dropped by electromagnets for cleaning, thereby obviating the necessity of periodically reversing the flow of water through the filters, as is commonly done with sand beds. Shipments of filtration material were made as far as the Pacific Coast.

Crude ore hoisted from the mine goes into a storage bin, from which it is withdrawn to the lump-ore plant. After passing through a crusher with jaws spaced 8 inches apart, it is elevated to the top of the plant by a 30-inch, 6-ply belt conveyor that inclines 22°. The belt discharges on to a Robins Gyrex screen of ⅜-inch mesh. All the material that drops through the screen goes into a railroad car for transfer to the fine mill. The oversize, constituting more than three-fourths of the total, falls on to a 36-inch, 4-ply conveyor belt that carries it over a Dings Hi-intensity, 16-ampere magnetic pulley revolving at 40 rpm. Pieces that contain enough ore to be attracted by the electromagnets are carried around the pulley and are not released until the belt loses contact with the pulley on its underside: pieces that contain little or no ore pass on over the top of the pulley to a belt that conveys them to a dump.

The material saved is fed to a Robins Gyrex double-deck screen. The upper screen is of 2½-inch mesh, the oversize being transferred to a picking belt. The lower screen is of 1½-inch mesh. The two thus divide the stream into material of

LUMP-ORE PLANT

All magnetite mined in this country was formerly crushed and then concentrated by magnetic separation. In 1937 a plant was designed and constructed by engineers of the Mount Hope Mine by means of which lump ore could be similarly treated. As a result, more than 45 per cent of the mine's output last year was marketed in the form of lump ore averaging an iron content of more than 62 per cent. This material is in demand by steel plants and brings a higher price than that of smaller size. After screening, primary separation is effected, as shown at the right. Pieces containing even a small amount of magnetite are carried around the magnetic pulley until the belt loses contact with its underside, while nonore-bearing rock goes over the top of the pulley and is conveyed to the dump. The ore then passes over two screens, and the material that drops through them is run over magnetic drums. Those that are too large to fall through the first screen are fed on to a picking belt (below) for inspection. The pickers let the good ore pass on to fall into a railroad car; lean pieces are thrown on to the belt at the right, which leads to the dump; and "middlings" are sent to the fine mill by the belt at the left for crushing and concentration.



MINE AIR COMPRESSORS

These two Ingersoll-Rand compressors furnish air at 100 pounds pressure for operating rock drills, sharpening equipment, hoists, chute gates, etc. Both are Class PRE, 2-stage units driven by General Electric synchronous motors. The one at the left is a 334-hp. machine with a piston displacement of approximately 2,025 cfm. The one at the right is of 600 hp. and its piston displacement is about 3,635 cfm. In the foreground is an Ingersoll-Rand centrifugal pump that lifts water to a reservoir from which it flows by gravity to the mine and to company-owned houses in Mount Hope. The unit has a capacity of 520 gpm. against a 217-foot head.

three sizes: in excess of 2½ inches, 2½ to 1½ inches, and 1½ inches to ⅞ inch. Each of the smaller sizes goes over a magnetic drum—a cylinder of manganese steel inside of which are electromagnets that are set about ⅛ inch away from the shell and that extend for 180° or halfway around the drum. In this type of separator the material makes direct contact with the drum, while in the pulley type the magnetic attraction is exerted through the belt on which the material rides. The drum handling the 2½ to 1½-inch size is of 7 amperes power and makes 23 rpm. Pieces passing over the drum go to the picking belt, while those that are carried around its magnetized section fall into a car for shipment. The magnetic drum for the 1½ to ⅞-inch material is of 5 amperes power and makes 23 rpm. It also turns out two grades: what adheres to the drum drops into a car for shipment, while the remainder is sent to the fine mill for crushing and concentration.

It has been found that the magnetic separators are more selective in cold weather than in warm, the reason being that the amperage stays up better. The machines are so powerful that even powder paper coming up from the mine with fine ore adhering to it will be attracted. Also, a large piece of rock containing ore in one or two small areas will be carried around the magnetic pulley if it happens to be resting on the belt so that one of the spots of ore is in contact with the pulley. On the other hand, a piece of good ore will not be attracted by the magnets if it rests on top of a rock as it rides along the belt. It is because of these factors that the larger sizes separated by the magnets are hand picked. The pickers, nine or ten in number, are stationed on each side of the belt. They have become so expert through experience that they can readily distinguish between ore and rock at a glance and can determine the grade of ore by its weight. They sort the material as it slowly flows by them, throwing rock for the dump on one belt, lean ore for the fine mill on another, and allowing rich ore to travel on over a pulley at the end of the belt, from which it falls into a car ready for shipment.

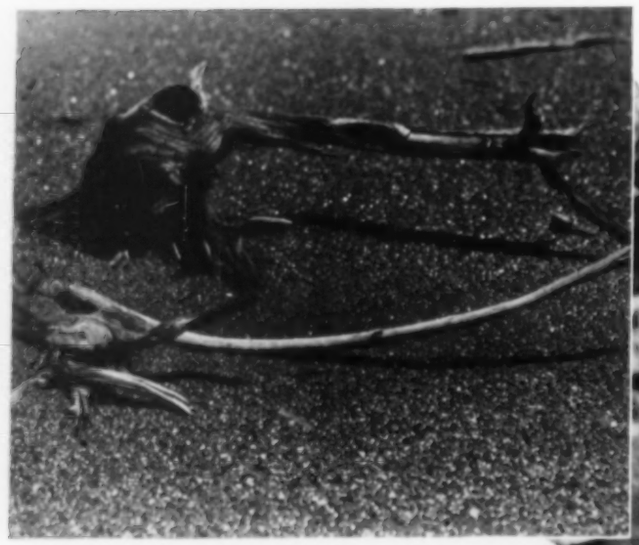
Magnetic separation is also used in the fine mill, the procedure, in general, consisting of crushing the material, screening it, drying it, and then passing it over magnetic rolls and through magnetic machines. There are ten of these units, eight of the drum type and two of the belt type. The fine mill has been in service since 1907.

Operations at Mount Hope are carried on in two shifts daily. Drilling in the stopes is all done by the day shift; about 70 per cent of the tramming and all ore hoisting are done by the night shift. The fine mill operates on the day shift and the lump-ore mill during the night shift. This schedule distributes the power load equably and permits using the shaft exclusively for the transportation of men and materials on the day shift. About 145 men are employed, 90 of them underground. Stoping is done under a bonus system, the bonus being based on the tons of ore broken. All development work is contracted, the company furnishing everything but blasting supplies. The earnings of the employees are above the average for their respective kinds of work, and the labor turnover is small.

Fred M. Radel is mine superintendent, Harrison Meeker is foreman, and Frank Morris is engineer. Warren Davenport is superintendent of the lump-ore mill and Harry Davenport is superintendent of the fine mill. Charles James is master mechanic, Charles Struble is chief electrician, and Edwin Spicer is surface foreman.

River Coal

L. A. Luttringer, Jr.



A RESIDENT of Harrisburg, the capital city of Pennsylvania, was showing a visiting friend some of the local points of interest. They were driving northward along the Susquehanna River when the visitor turned to his host and inquired: "What are those funny-looking boats out there?"

The Harrisburg man shifted his eyes toward the stream to single out the craft referred to. "They're coal dredges," he said.

"Coal dredges," his friend repeated.

"Sure. They pump coal from the river bottom, haul it to the shore, and sell it to power plants, steel mills, and other large concerns."

Coal has been reclaimed from the streams leading from Pennsylvania's famous anthracite region for more than 50 years, and the industry has been commercially important for the past 30. It was started by people who lived along the waterways and recovered the fuel for the family hearth. Lacking up-to-date equipment they employed hand shovels and screens. At the outset they foresaw no outlet for the coal; but once they realized that they could take out more than enough for their own needs, they increased their production and began selling the surplus to their neighbors. As time went on and the market grew, they developed more efficient and practical means of reclaiming the fuel.

The advent of the steam-engine conveyor-type of dredge was the first step in the commercial exploitation of river coal; but it wasn't long before some of the more prosperous operators had scraped together enough capital to purchase even better equipment. A few of those who started with shovel and hand screen now

COAL BARGE AT HARRISBURG

A stern-wheel boat is seen at the upper right pushing a barge laden with river dredged coal in the Susquehanna, with the dome of the Capitol of Pennsylvania in the background. The three other views show points of origin of river coal. Small streams, like the one directly above, flow along culm and silt banks near mine breakers and carry much fine anthracite with them, as the center picture, with the handful dipped up from the bottom of such a waterway, illustrates. The waste banks in the anthracite fields (upper left) resemble stretches of desert.

own fleets worth more than $250,000. These large-scale plants are located mostly along the Susquehanna, the smaller ones reaping their harvests from tributary creeks.

There are two sources of river coal: mine breakers and culm and silt banks, or waste piled up at the collieries. The banks have accumulated in the course of many years and contain large quantities of coal that is of commercial size today but that was once discarded because it was too small to burn in the equipment then available. For example, buckwheat No. 1 (¼ to ½ inch) was formerly unsalable and was therefore dumped at the mines. Now, however, it is so much in demand that it is often necessary to crush bigger sizes to obtain enough of it. The next smaller size, rice or No. 2 buckwheat (3/16 to ¼ inch), is used regularly in some domestic heating plants, while barley, or No. 3 buckwheat (nominally 3/16 to 3/32 inch), and birdseye, or No. 4 buckwheat (smaller than 3/32 inch), are burned in many power plants and other establishments that are provided with suitable combustion apparatus.

Much of the river coal comes from the mine breakers, being carried away by the water that is used to wash it. Many old-style breakers are still in service and waste considerable quantities of fine coal into the streams. This loss is increased by reason of the difficulty of building up and maintaining good silt banks in the narrow valleys that are characteristic of the Pennsylvania anthracite field. However, it is probably less than in the past, and will no doubt decrease sharply in the next few years because of the erection of large, new-type breakers that will handle the output of several collieries, utilize the fine sizes more fully, and store the silt more securely. Be that as it may, breakers still are the principal source of supply.

The coal now entering the streams with the wash water rarely exceeds No. 4 buckwheat; and by the use of proper settling tanks and thickeners it would undoubtedly be possible to prevent the loss of all but a small percentage of the extremely fine material that would have little value as river coal. But this method of handling the silt would probably raise the production cost to a point where it would be prohibitive, especially as it would involve treating the water used in cleaning the jigs which separate the slate and coal.

Just how much coal the culm and silt banks at the collieries contribute is a disputed question. However, according to one year's estimate, there was piled up in the field a total of 217,750,000 long tons of culm and silt. This means that the supply of river coal from this source would be large under any circumstances. As old banks are washed away and newer ones are protected with rock, the amount will of course gradually diminish; but even if the waste from the culm and silt piles as well as the breakers were to be cut off entirely, the accumulations on the bottoms, banks, and alluvial flats of watercourses leading from the anthracite region would, it is estimated, provide coal in commercial quantities for from seven to eight years.

In the Susquehanna River, coal is found in bars and pockets as far away as the Maryland line. It shifts and moves so rapidly that it is impossible closely to estimate the amount, but it is probably something more than 500,000 tons. The tonnage on the bottom at any one time in a given area is relatively constant, for as the coal is carried downstream it is deposited repeatedly in the holes or riffles that ordinarily hold it. As one operator put it, the bottom is like a wagon box which, when full, lets any additional material slide off the top. As the coal at any one point is recovered, the pockets fill up again, provided, of course, there is enough water to deliver a new supply from up river. The quantity in the creeks tributary to the Susquehanna is problematical; but it must be well over 1,000,000 tons. Most of that coal is of high grade. There is also an enormous amount in flood plains and along the banks of streams. However, this is gradually being cleared away as the submerged stores are reclaimed and the waterways cut into these old deposits.

The purity of the coal in the Susquehanna varies in accordance with the place and the time of the year, the proportion of slate and bone decreasing with the dis-

tance from the mines. On the other hand, the coal down river contains more sand and gravel; but separation is easily effected by the use of screens of different sizes. The rate at which the coal is borne downstream varies. In the smaller and swifter watercourses, the progress of the fine material is very fast: in the river, however, the movement is much slower, and is governed largely by water conditions and by the size of the coal—that is, it travels quickest in spring during the flood period and hardly at all in summer when the water is low. Ice gorges also help to disturb the coal and to bring it down the Susquehanna.

The quantity of coal taken from the streams varies much from year to year. Since dredging began in 1889, approximately 13,000,000 tons have been reclaimed. This figure may be conservative, because statistics have been available for only a little more than ten years—the production during the last decade accounting for nearly half the total. The greatest output was in 1919, when 1,935,000 tons were recovered in response to the demand created by the postwar boom. In the next two years the production declined sharply, then went up, and from that time on has settled down to about 750,000 tons annually. Most of the supply comes down in spring, and when that has been exhausted, the operators in the Susquehanna, at least, must shut down their plants and wait for rising water in fall to bring down more.

Of late years, the number of dredges on the Susquehanna River has increased greatly, with the result that the coal is taken out faster. In consequence, the dredging period in the spring and early summer has been shortened, until now most of the coal is reclaimed in from six weeks to two months. By the middle of July, all but a few of the craft are idle, and those that are working get only fine-sized material. In 1930 the slack season was a protracted one by reason of low water, which made it impossible to float the flatboats even where deposits were located.

On the other streams, the midsummer shutdown is even more marked, because nearly all the plants are stationary—unable to move in search of bars when the waters cease to wash down coal. There are only a few creeks on which it is profitable to operate throughout the summer months, and even on those many of the outfits sometimes come to a virtual standstill on account of abnormally low water.

The size of river coal is the factor that largely determines where and how it can be used. That it is getting finer all the while is obvious. From 20 to 30 years ago, substantially all the dredged material was of buckwheat size and larger, with some nut and stove coal. Now, however, the bulk of it is barley and birdseye, or No. 3 and No. 4 buckwheat. The quality, except for a higher ash content, differs little from that of newly mined coal from the same field.

The methods of dredging and screening depend on the size of the streams. On the Susquehanna and other rivers, the coal is recovered by means of a rotary pump mounted on a flatboat and powered by either a steam or a gasoline engine. From the pump the material is run over screens on to barges, which are poled or pulled to shore by a stern-wheel tug for unloading at permanent or temporary landings. This is the method in general use today. Some of the small-scale operators continue to do the work with endless-chain bucket diggers or conveyors on dredges and claim that, although their output is not large, they can skim the tops of the bars with them and get only the cleaner and larger coal, thus eliminating rewashing or screening and insuring a coarser and better product. In the case of creeks that are too small to float barges, dependence is placed on stationary equipment such as pumps and buckets that deliver the material right on shore. It is a little cheaper than the barge system and permits the use of cleaning devices such as concentrating tables.

The problem in the production of river coal is marketing it at a price that will insure a fair return on the investment. In the early days of the business, the sizes were so large that the fuel could be burned in ordinary domestic furnaces, and much of it was consumed in that way. Later,

A DREDGE AT WORK

Rotary pumps suck the fine coal up from the river bottom, together with water that washes it over screens and delivers it to a barge.

UNLOADING A DREDGE
After being towed to the shore, the barge is frequently unloaded directly into delivery trucks. A bucket type of conveyor is shown here. As the barge is pulled along underneath it, the buckets dig into the pile of coal, as seen below, elevate it, and dump it into a hopper, which feeds a conveyor belt that moves it to the truck.

when the quantity of domestic sizes dwindled, steam sizes became commercially important. Then most of the output went to large industrial establishments that had automatic stokers and blowers designed for burning fine coal. Many home owners, especially in the vicinity of Harrisburg, installed blowers for that purpose, but the amount so used is relatively small.

As it is becoming increasingly hard to find coal large enough or suitable for ordinary stoker furnaces, some concerns are burning it efficiently in plants built especially for it. Hand firing also is resorted to, and pinhole grates with blowers are in service; but on account of the labor item few big establishments make use of them. Pulverized river coal is burned to advantage because nothing is wasted; but it has one drawback, and that is that it is difficult to provide material free of sand. So while most companies using it would like to have the sand content reduced to anywhere from 3 to 5 percent, the fuel usually contains from 8 to 10 per cent.

Although most river coal is consumed for raising steam, approximately 20,000 tons a year is utilized for recarburizing steel in the open-hearth process. For this purpose it must be carefully washed to get rid of the sand, for any trace of it would form iron silicate and render the steel brittle. For some reason, as yet undetermined, river coal gives better results than ordinary anthracite: the former is said to have none of the freshly mined coal's tendency to make steel cold-short (brittle when cold). It is therefore preferred for this service, and will be used so long as it does not get too fine to clean properly. In the case of a recarburizing agent the cost is less important than the quality.

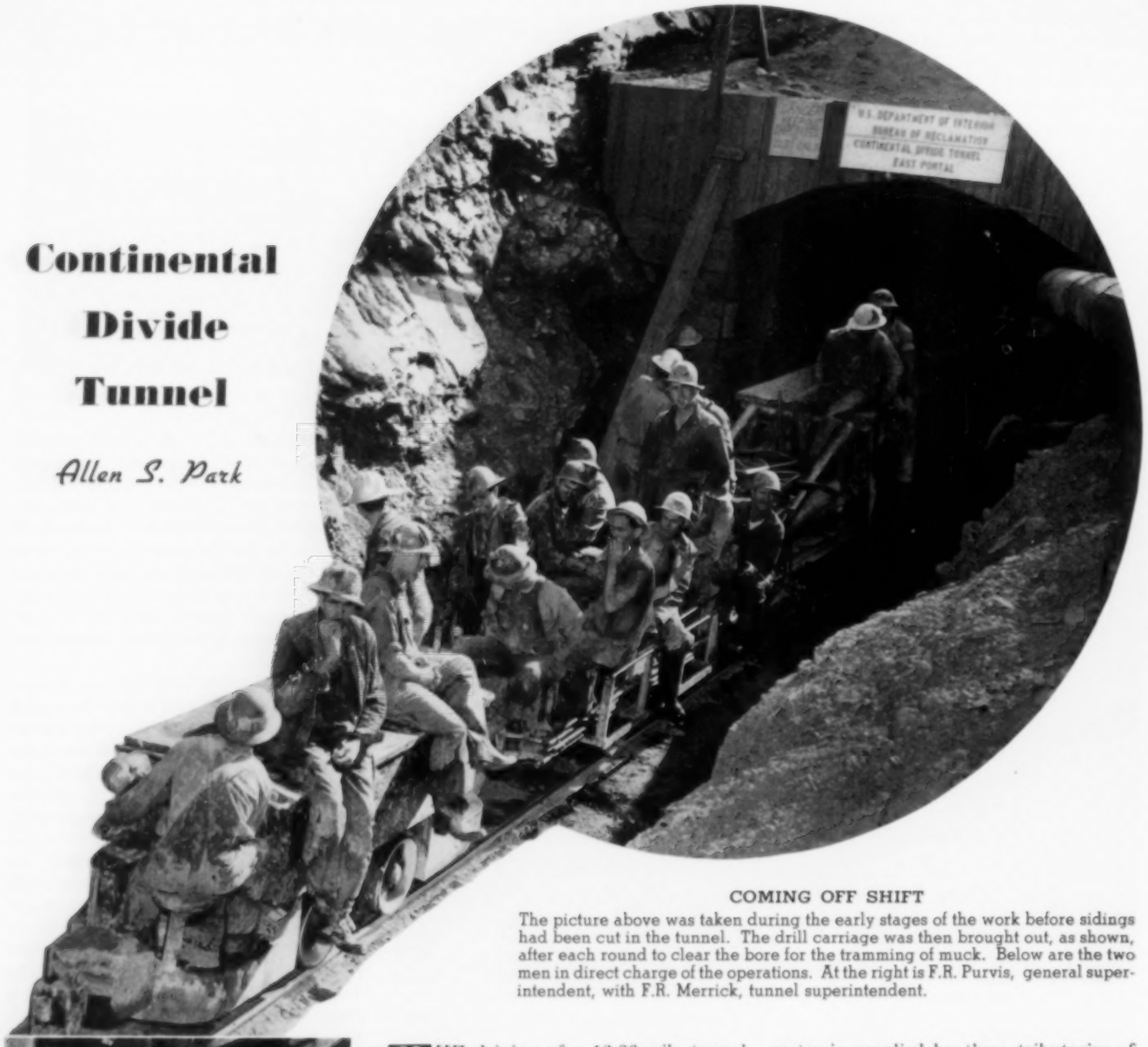
Figures for 1937 give some idea about the scope of the industry. During that year, 33 dredges were in operation on the Susquehanna and other eastern Pennsylvania rivers, and they recovered 760,474 net tons of coal valued at $842,052. The average price received per ton was $1.11. The future of the business depends, of course, on the anthracite industry—what provision it makes to prevent waste and stream pollution, and on the difference in price between fine-sized coal from the river and from the colliery. Obviously, if the latter is high, the reclaimed fuel will have a bigger and wider market; but if the differential is not enough to make up for the higher ash content and size of river coal, the demand for it will unquestionably drop.

While the sources that feed the streams are gradually diminishing, and the coal is getting finer and poorer in quality, other factors such as new equipment for burning small sizes and reduced freight rates are at work tending to improve the industry of recovering wasted anthracite. The indications are that the business will remain virtually stationary during the next five years and that the number of operators will decrease—the less important ones being forced out while the bigger ones will install more effective machinery for reclaiming and preparing the fine sizes and will make their money by taking a small profit on a large tonnage. Towards the end of that period production will probably begin to decline, although a few of the big dredges will continue to take measurable quantities of coal out of the river for perhaps twenty years longer. Eventually, however, coal-dredging will be combined with sand-dredging, as is already being done on a small scale on the lower Susquehanna. It goes without saying that as long as coal is mined in the anthracite region coal will be found in the streams leading from it.

Although the writer has talked with many old rivermen, there seems to be no tradition or folklore coupled with the industry, except that which naturally follows any transition from primitive to modern methods. The operation is obviously safe, for few if any drownings have been recorded; but hearsay has it that men working on the barges have on more than one occasion been instrumental in saving persons from drowning. Despite the lack of any colorful history, the fact is that the industry stands apart and therefore deserves a place in print.

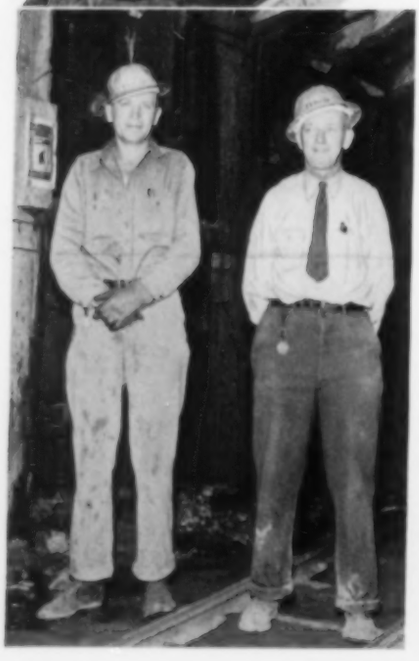
Continental Divide Tunnel

Allen S. Park



COMING OFF SHIFT

The picture above was taken during the early stages of the work before sidings had been cut in the tunnel. The drill carriage was then brought out, as shown, after each round to clear the bore for the tramming of muck. Below are the two men in direct charge of the operations. At the right is F.R. Purvis, general superintendent, with F.R. Merrick, tunnel superintendent.



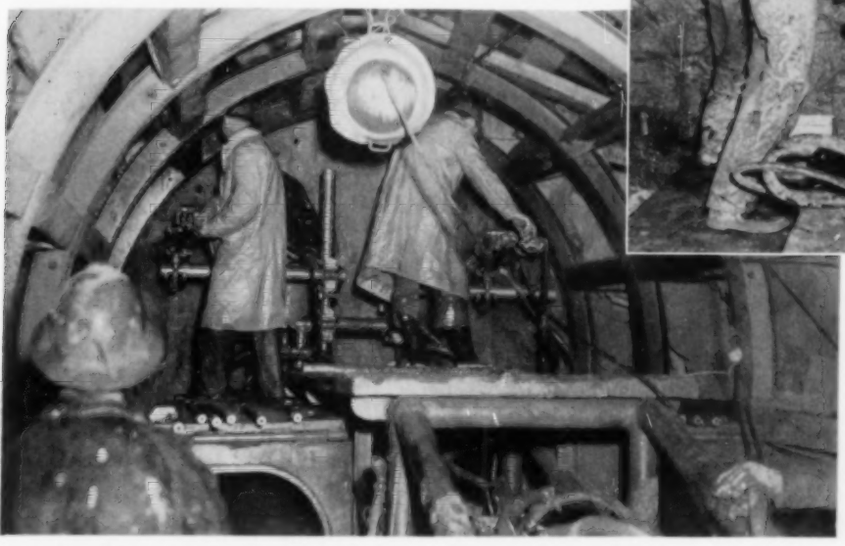
THE driving of a 13.06-mile tunnel through the Continental Divide in Colorado to divert the headwaters of the Colorado River from the western to the eastern slope is underway. This 69,023-foot bore is but one link in a scheme for supplying additional irrigating water to 615,000 acres now under cultivation. A general description of the undertaking, which is being carried out by the U.S. Bureau of Reclamation under the name of the Colorado-Big Thompson Project, was given in our March, 1938, issue. To refresh the reader's memory, it will be briefly summarized here.

Some of the most fertile land in the West lies just east of the Rockies in northern Colorado. It was there that Horace Greeley formed his Old Union Colony. It was there that Charles Boettcher raised the first sugar beets grown in America and established an industry that has expanded until there are now 100 sugar-beet processing plants in the nation. All this acreage has to be irrigated to be productive. The water is supplied by three tributaries of the South Platte River that obtain their flow chiefly from snowbanks high on the range. These watercourses are the Cache la Poudre, Big Thompson, and St. Vrain rivers. They are in flood stage during the spring and early summer, when most of the previous winter's accumulation of snow at their headwaters is melting. During the remainder of the summer their flow steadily diminishes, save for briefly held rises following infrequent rains.

These conditions make it necessary to store water during high runoff periods for use during the growing season that extends well into the autumn. All told, 60 reservoirs have been built for this purpose, as well as 124 canals to deliver water to 6,400 farms. These systems represent expenditures of $35,000,000. Most of the reservoirs were constructed between 1890 and 1910, and they amply met the requirements during that time and up to about fifteen years ago. Since then, however, there has been a cycle of low runoff,

INSIDE THE BORE

Below is shown an unusually clear picture of actual drilling operations at a heading. Both the DA-35 drills on the upper level of the carriage were in action when it was taken. At the right is an equally good one of the upper holes in the act of being loaded with powder. The two drills in the center have been folded back out of the way. The dirt on them indicates the conditions under which such machines regularly work. Of the two cars in the lower view, the one on the right is loaded and being shifted back from the heading, while an empty is being brought forward for loading. The switch is of the portable California type that is placed on top of the regular haulage rails, thus creating a temporary double-track section.



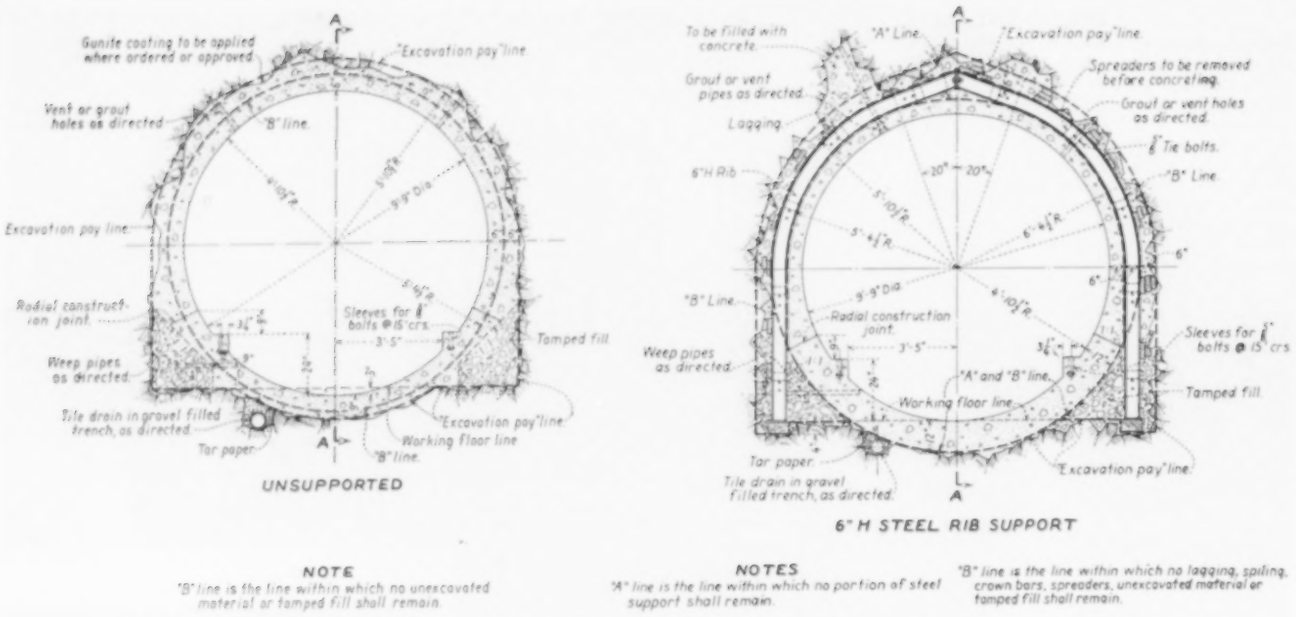
and it has been computed that for the period 1925-35 the average yearly deficiency in water diverted from the streams for irrigation was 575,000 acre-feet. The average annual loss of crops resulting from this shortage is placed at $4,700,000, while in the abnormally dry year of 1940 it was considerably more.

By contrast, the western slope has more water in an average year than it needs. This is chiefly because the snowfall is heavier on that side of the range. Accordingly, under the Colorado-Big Thompson Project, 310,000 acre-feet of water from the headwaters of the Colorado River will be diverted annually to the eastern slope through the Continental Divide Tunnel. Reservoirs for storing it and canals for delivering it to the established distributing systems will be built. To insure the western slope against any possible shortage, Green Mountain Dam is being constructed on the Blue River, a tributary of the Colorado, to impound 152,000 acre-feet of water. Of this, up to 50,000 acre-feet a year will be allocated to replace the water that is to be diverted to the east side of the range. Records of runoff and consumption indicate that this will be sufficient to make up any shortage, even in an abnormally dry year. The remainder of the storage will be allocated to power generation. Green Mountain Dam, which has been underway since December 1, 1938, will be an earth-and-rock-fill embankment 1,300 feet long at the crest and 270 feet high. It will be the second largest and highest structure of the type to be built in the country, being exceeded only by San Gabriel Dam No. 1 in California.

To collect the water that is to be diverted, a dam to impound 482,860 acre-feet will be built on the Colorado River at a point 6 miles northeast of the Town of Granby. Its supply will be augmented by canals extending from three tributary streams of the Colorado that enter the river below the dam site. From Granby Reservoir the water will be lifted approximately 130 feet by pumps and delivered to a 4½-mile canal leading to Shadow Mountain Lake, which will be created by damming the North Fork of the Colorado about half a mile downstream from the point where it now flows out of Grand Lake. The latter is the largest natural lake in the State of Colorado and occupies a basin scoured out by a glacier. The dam will back up the water to Grand Lake and will, in effect, enlarge it. Delivery of water from Grand Lake to the Continental Divide Tunnel will be made by a canal 67½ feet wide, 15 feet deep, and 740 feet long.

From the eastern portal of the tunnel the water will flow to the Big Thompson River through 5.36 miles of conduit of which all but 1.33 miles will be covered. Before entering the stream it will pass through two turbines each of which will operate a 15,000-kw. generator. This will be the only power plant included in the initial construction, although when the plan reaches its ultimate development there will be four more generating stations on the eastern side of the range and one on the western side at Green Mountain Dam. The capacity of all six will be 142,500 kw. A transmission line will cross the range from the Big Thompson plant to supply power for operating the pumps at Granby Reservoir.

Although the project has been worked out on the basis of diverting 310,000 acre-feet a year, it is figured that the amount will average 320,000 acre-feet. It is also calculated that, if an additional 310,000 acre-feet is distributed to the farming lands, there will be a usable return to the streams of 214,500 acre-feet. Another 30,000 acre-feet is expected to be returned to eastern-slope streams as a result of the diversion of western-slope water by the City of Denver through the Moffat and Jones Pass tunnels. It is further expected that the new reservoirs to be built will provide storage for 16,000 acre-feet of Big Thompson River water that is not now



NOTE
"B" line is the line within which no unexcavated material or tamped fill shall remain.

NOTES
"A" line is the line within which no portion of steel support shall remain.

"B" line is the line within which no lagging, spiling, crown bars, spreaders, unexcavated material or tamped fill shall remain.

TYPICAL SECTIONS AS EXCAVATED AND LINED

being impounded. The total supplemental supply will, consequently, be 580,500 acre-feet, or slightly more than the computed average shortage.

It is estimated that the ultimate construction cost will total $54,288,000. A maximum of $25,000,000 of this sum will be charged to the Northern Colorado Conservancy District for irrigation, while the remainder is to be repaid by net power revenues. The proportion chargeable to irrigation amounts to about $80 for each acre-foot of water that will be diverted. To insure the Government reimbursement, the Bureau of Reclamation has contracted with the water user (Northern Colorado Conservancy District) on the basis of $2 an acre-foot for 40 years. Repayment of the expenditures for power plants is expected to come from the sale of energy, it being understood that additional generating facilities will be provided only when the demand for electricity warrants them.

It was the original intention of the Bureau of Reclamation to let a single contract for the driving of the Continental Divide Tunnel, approximately 69,000 feet long. Bids on this basis were opened on June 7, 1939, and all were rejected as being too high. New ones were obtained; but they were also rejected for the same reason. To get the work going without further delay, it was decided to excavate short initial sections from each portal and, upon completion, to follow these with additional contracts. As a result of the bidding under this plan, contracts were let for 8,000 feet at the east portal and 6,600 feet at the west portal, and operations were started at both in 1940. Work at the west portal is being done by Platt Rogers, Inc., of Pueblo, Colo., on a bid price of $389,370. The operations at the east portal, to which the remainder of this article will be devoted, are being conducted by S.S. Magoffin Company, Inc., of Englewood, Colo., which was awarded the contract on a bid of $471,123.

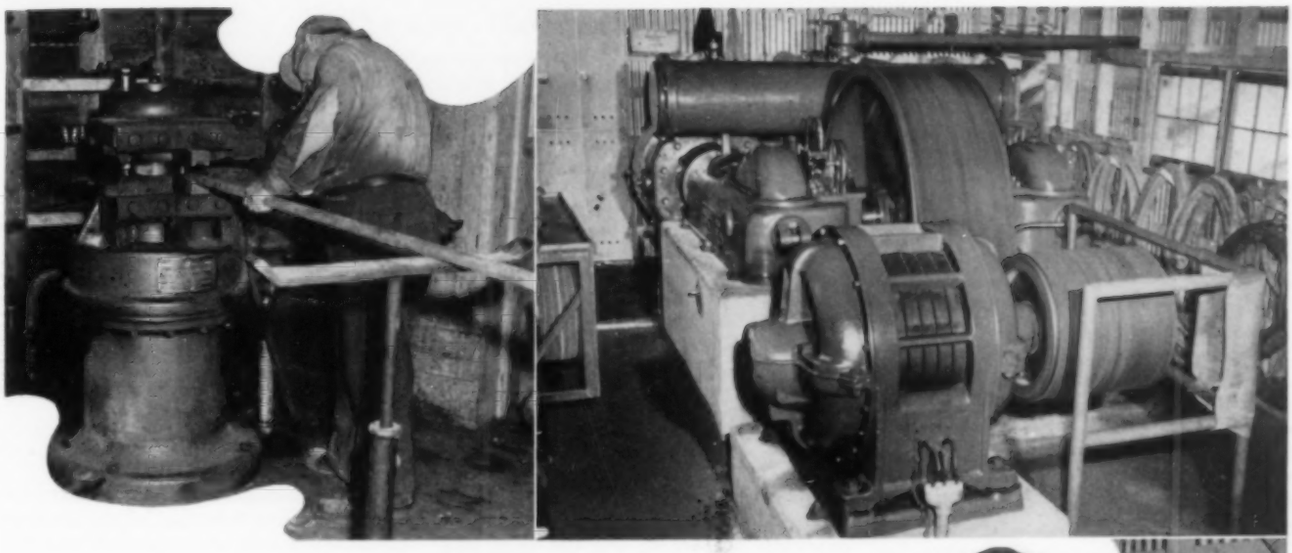
As driven, the tunnel has a horseshoe-shaped section. Both the width and height are nominally 11 feet 9 inches in unsupported ground and 12 feet 9 inches in supported ground. It will be lined with concrete to form a circular section 9 feet 9 inches inside diameter. Accompanying drawings show details of both supported and unsupported sections. Contractors are being penalized $15 per cubic yard for overbreak. The elevation of the west portal is 8,358 feet, and that of the east portal 8,250 feet, giving the tunnel a gradient of 0.156 per cent to provide for gravity flow of the water. Close to the eastern end there will be a dam to divert the water into the conduit system extending to the Big Thompson River. The construction of a part of this dam is included in the Magoffin contract. It will be an earth-and-rock-fill structure, with a concrete core wall 3 feet wide at the bottom and approximately 2 feet wide at the top. It will create a lake with several acres of surface area that will enhance the scenic beauty of the section, which is adjacent to Rocky Mountain National Park, one of the favored summer tourist regions of the West.

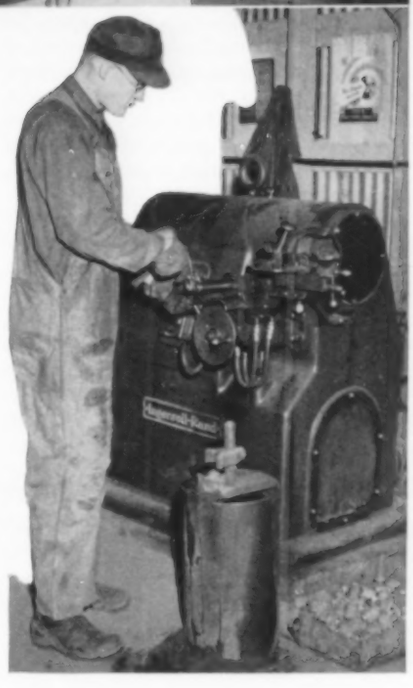
By the time this article appears in print, the Magoffin forces will have finished driving their 8,000-foot section and will probably have begun operations on an adjoining 7,000-foot section which was awarded to that company on February 3 on its low bid of $478,711. At this writing the expectations are that the final blast on the initial contract will be set off early in February and that the latter will be completed about six months ahead of schedule. After it was let last April, the contractor assembled and set up the necessary plant and machinery and started open-cut work. The portal was faced on June 13, and ten days later, on a Sunday, 2,500 persons attended ceremonies at which tunneling was officially inaugurated. At the end of June, the heading had been advanced 275 feet, progress being retarded by a lack of complete equipment and the need of organizing the crews and establishing a smooth-running schedule.

Since July 1, the footage, by months, has been: July, 932; August, 1,113; September, 1,041; October, 1,147; November, with six inactive days, 922; December, with two inactive days, 1,135; January, 1,301. The average daily progress from June 13 to February 1, 1941, has been 33.7 feet: the best footage for a single day 56 feet. The rate of advance has been very high when it is considered that 50 per cent of the tunnel has had to be supported with 6-inch H-beams set on 4- and 5-foot centers, and that it has been necessary to use short rounds to keep down the $15 penalty. The setting of the steel and of the associate timbers wherever the nature of the ground required them has taken up considerable time in the course of each cycle of operations.

The first 1,200 feet was driven through biotite schist. Since then various kinds of granite have been penetrated, some of the rock being reasonably tight but much of it blocky and loose. On October 1, a flow of water at the rate of 250 gpm. was encountered but was successfully stopped by grouting. It was expected at the outset that some water would have to be dealt with, as the tunnel line passes under a small glacier and a number of glacial lakes.

Drilling was done from a structural-steel drill carriage with five Ingersoll-Rand DA-35 drifters equipped with power feed.





IN THE BLACKSMITH SHOP

A Type XCB compressor (upper right) and a smaller unit supplied air for drilling, mucking, and for other services. Jackbits were used throughout the contract and were reconditioned by the JMA Jackmill at the right. Shanking and other forming operations on Jackrods were done by an I-R No. 50 sharpener, upper left.

Four of these machines were positioned for regular drilling, while the fifth, which was mounted in the center of the front end, was used to drill only test holes in advance of the heading in doubtful rock. Jackbits, of the Type 1 Sibley style, were employed from the beginning. Starter bits were of 1⅞- and 1¾-inch gauge, with succeeding ones ⅛ inch smaller with each change of steel. The bits were affixed to 1¼-inch hollow, round Jackrods which were made up in sets of 3-, 5-, 7-, and 9-foot lengths for each round. Dull bits were removed from the rods and sharp ones substituted in the blacksmith shop outside the tunnel, two steel cars serving to transport the assembled members in and out of the tunnel. By this arrangement, a full set of steel for a round, ready for use, was available to a drilling crew at the start of each round. A typical drilling pattern consisted of from 36 to 40 holes, being varied somewhat according to the nature of the ground. The advance per round ranged from 5 to 9 feet, this also depending upon the kind of rock being drilled.

Blasting was done electrically with du Pont explosives and detonating caps with delays ranging from first to tenth. The powder consumption per cubic yard of rock broken averaged about 8 pounds. For each linear foot of advance, there was excavated approximately 4.1 cubic yards in unsupported sections and about 4.8 cubic yards in supported sections.

Mucking was done with an Eimco-Finlay No. 21 loader, with a spare unit held in reserve at all times. Muck was hauled in steel cars, with a capacity of 91 cubic feet, drawn by 3½-ton Mancha storage-battery locomotives on a 24-inch-gauge track of 40-pound rails. Full cars were moved back from the heading and empties run up into loading position by means of a conventional California switch. The muck cars, which were built by the C.S. Card Iron Works Company of Denver, were equipped with detachable, roller dumping arms. These were attached to the sides of the cars when they reached the dump and served to tilt and empty them when the arms passed over a dumping block or ramp. The arms were removed before the empties were returned to the tunnel A complete drilling and mucking cycle in sound rock that did not require support averaged about 3½ hours, and on occasions was reduced to as little as 2½ hours. Considerable sacrifice in speed had to be made on account of the continually changing character of the ground and the desirability of avoiding excessive overbreak.

Ventilating air from a blower driven by a 40-hp. motor was conveyed to the working face through a 20-inch-diameter pipe. This was installed in 30-foot lengths and bolted together, with a rubber gasket inserted at each joint, to insure a tight connection. A 4-inch air line and a 2-inch water pipe to serve the drills also extended to the heading. The placing and servicing of these various lines was done by the track or "bull" gang.

For reconditioning Jackbits and for making up Jackrods, there were set up in the blacksmith shop an Ingersoll-Rand JMA Jackmill, two Jackfurnaces, a No. 50 drill-steel sharpener, a lathe, a drawing pot, quenching fixtures, etc. In a separate building was an Ingersoll-Rand Type XCB 2-stage compressor and a smaller unit which supplied air for drilling, mucking, and other purposes.

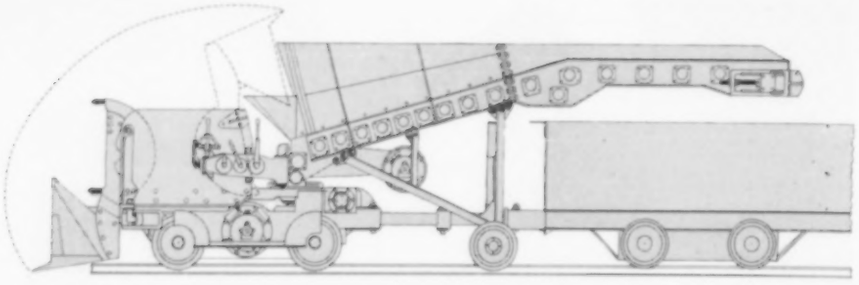
Work was carried on 160 hours a week in three 8-hour shifts and one "crazy" shift. Operations were shut down for eight hours every Sunday for repairing and servicing equipment. An average force of 112 men was employed in the tunnel and on the diversion dam. In the interest of accident prevention, a safety club was organized at the outset and met monthly to discuss means of safeguarding the employees.

Porter J. Preston was retired as supervising engineer for the U.S. Bureau of Reclamation on the Colorado-Big Thompson Project in December, 1940, and C.H. Howell, who was formerly in charge of construction, is now acting supervising engineer. Frank Matajeko is associate engineer at the east portal. F.R. Purvis served as general superintendent for the S.S. Magoffin Company, Inc., with F.R. Merrick as tunnel superintendent and Jake Brotzman as night tunnel superintendent. Grant McCullough was foreman of the dam construction, and G.R. Campbell was office manager.

Eimco Tunneloader

THE Eimco Corporation of Salt Lake City has developed a new mucking machine, the Tunneloader, which is larger and more powerful than any of its present models and will load the largest cars used underground with speed and economy. As the illustration shows, the Tunneloader retains the Eimco-Finlay rocker-arm mucking action—crowding the bucket into the muck pile by its self-tramming power and rolling the bucket-and-rocker-arm assembly over backward on a supporting track to its dumping position against the bumper springs. Improvements in the mucking action include a separately powered self-locking worm-and-gear mechanism for swinging the bucket assembly to any desired digging position without manual effort by the operator, and elimination of the need for "centering" the bucket assembly before dumping. The latter advantage has been made possible by the introduction of a hopper into which the bucket discharges from any digging position instead of dumping into a car with which it has to be lined up first.

The hopper feeds the rock on to a short belt conveyor, permitting the loading of cars with bodies up to 15 feet long and 6 feet high above the rails. The conveyor is separately powered and can be started and stopped by the operator from his normal loading position. He can also vary its speed within a wide range—all by the same conveniently located control lever.



CONSTRUCTION DETAILS

The over-all length is 23 feet 9 inches, the width of the hopper is 6 feet 8 inches, and the maximum headroom required for operation is 7 feet 10 inches. The bucket handles from 9 to 12 cubic feet at a time, loads from 50 to 75 cubic feet per minute, and can satisfactorily clean up a 15-foot-wide tunnel. Track ranging in gauge from 30 to 56½ inches may be used. The loader is operated by four compressed-air or electric motors, two of 18-hp. each and two of 6-hp. each.

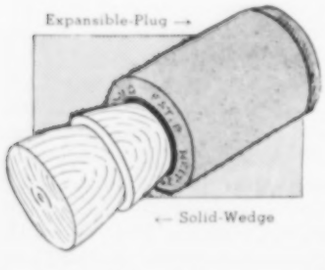
Normally, the car to be filled is coupled to the loader, as illustrated. Long cars are uniformly loaded by the use of a long coupling bar which slides in a sleeve cored throughout the length of the loader frame and is provided with a number of spacing holes for the coupling pin so that the position of the car with respect to the loader can be varied. If desired, the car can remain attached to a locomotive and kept spotted under the conveyor discharge by the locomotive operator.

The weight of the Tunneloader is about 12,000 pounds and is moderate in comparison with its loading capacity of more than 3 tons per minute. The low weight is the result of relatively simple design and construction and the use of heat-treated alloy-steel castings and forgings for all highly stressed parts. The selling price is said to be lower than that of any previous mucking machine of comparable capacity.

Other features are sectionalized construction, which permits traveling around relatively sharp curves, easy dismantling for transportation or caging, moderate head-room requirements, and low operating and maintenance costs. The four motors—tramming, bucket-elevating, bucket-swing, and conveyor—can be either of the radial compressed-air type shown or any standard electric motor. When compressed-air motors are used, the average air consumption at 70-100 pounds pressure should not exceed that of two drifter drills. Data given under the drawing are subject to some variation because the design can be modified to meet special needs.

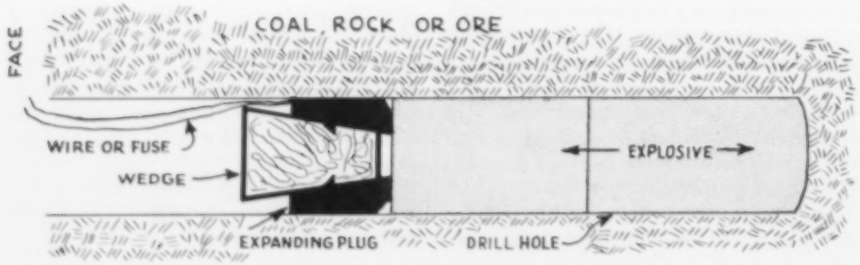
Adaptable Plugs for Stemming Drill Holes

SAFETY in blasting drill holes in underground and surface operations is promoted, it is claimed, by a scientific method of stemming introduced by The Heitzman Company. The system has had months of application under service conditions, and is becoming standard practice in numerous mines, tunneling, and other operations because of its advantages over ordinary stemming. By this method, an incombustible, elastic plug is pushed by a regular tamping stick against the explosive charge in the drill hole. The plug is a simple affair, and is made up of a thimble-shaped cup of rubber or asbestos and of a conical, chemically treated wooden wedge that fits snugly into the cup. When in place, the solid wedge is tapped several times with the tamping stick until a ringing sound indicates that the charge is sealed. Or the plug can be lodged at any desired point to create an air cushion between it and the explosive.



THE PLUG AND HOW IT IS USED

One type with an all-rubber cup is intended for surface blasting, while an asbestos cup with a rubber base is for underground operations. The latter has many folds, not unlike an umbrella, which open up when the wedge is forced down into it, causing it to conform to the wall of the drill hole and to seal it.



Under the impact of the blows, the cup expands, tightly sealing the hole and eliminating the need of further stemming. This is a time- and labor-saving factor of no small importance. With the charge thus effectually confined, the force of the blast is exerted against the rock, assuring maximum breakage per foot of hole and pound of explosive. It is further claimed for the device that it reduces the hazard of misfired holes. Instead of digging out the explosive or drilling a parallel hole, the charge is refired by inserting into the hole first an additional stick of explosive suitably primed and then a second blasting plug. In this way the new primer causes the initial charge to be detonated through the first plug by propagation. Safety blasting plugs are available in standard sizes 1¼ to 2½ inches in diameter. Smaller plugs down to 1 inch and larger ones up to 6 inches in diameter are made to order. As they take up little room, this method of stemming has come to be known as vest-pocket stemming.

Texas Holds Highway Week

ALONG TEXAS HIGHWAYS

At the left is a stretch of divided highway north of Austin on Route 81. The other picture shows a bridge across the Red River, north of Bonham, on State Road No. 78. The highway system of Texas totals 26,500 miles.

IN AN effort to make its residents more conscious of the importance of its highway system, Texas recently held a statewide "Highway Week." It was sponsored by the Texas Good Roads Association, which has a membership of 25,000, in coöperation with the state highway commission and the highway department. Programs were arranged in virtually all the 254 counties, and more than 700 talks were given. A newsreel from a motion picture depicting the varied uses of the highways and their importance in business, industrial, agricultural, and social activities was shown to more than 4,000,000 persons; colleges and other educational institutions stressed roads and motor transportation in their classrooms; and newspapers told the story of the development of the state's highways and outlined the problems confronting their extension and improvement.

The object back of the movement was to obtain additional financial support from the Federal Government and to induce the state legislature to submit to the voters a constitutional amendment that would, if passed, prevent the diversion of taxes paid by motorists to purposes other than roadbuilding.

National-defense agencies have included 6,375 miles of Texas roads in the network of strategic military highways. This is about one-twelfth of the national total. Texas holds an important place in the national-defense program by reason of its long Mexican border and its great extent of coastline, and because it offers ideal locations for military training camps. More than 40 army, navy, and air-corps posts, bases, and fields have been established in or designated for the state. The fact that Texas is the greatest oil-producing and refining state gives it added standing in this respect. It is planned to make "Highway Week" an annual event.

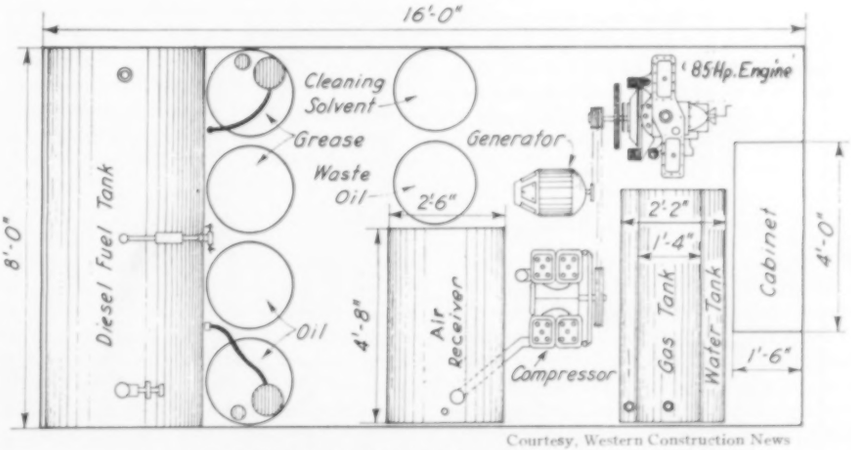
Air-Enveloped Lights

IN LARGE spray booths for painting airplane wings, the problem of safe illumination was solved by one concern by the use of compressed air. The booths measure from 35 to 40 feet from the entrance to the back where a curtain of water, together with a current of air moving toward it at the rate of 100 cfm., rids the chamber of spray and fumes which are harmful to the operators. The solvents with which the paints are mixed are explosive, and all lights and wiring must be protected so the vapors cannot reach them.

To illuminate all surfaces of the wings, the booths have vaporproof fixtures both inside and outside. Ranged beneath the ceiling and along the walls of a 35-foot chamber are fourteen 200-watt lamps, and windows admit light from the exterior fixtures. By the new system, the glass area has been considerably reduced by the use of prismatic reflectors, and the 200-watt lamps are of 37 instead of 10 foot-candles; are of the box type with reflector; and are suplemented by air connections. Each unit, when burning, is charged with air at one pound pressure, and this is sufficient to prevent the paint vapors from coming in contact with the lamp, thus eliminating the danger of an explosion. In case of failure of the air supply, the lights will not burn; and should a box be open for any reason, a mercury switch will promptly turn out the particular lamp.

Lubricating Heavy Equipment on the Job

THE work of lubricating the heavy equipment used in the construction of Prado Dam near Corona, Calif., is being expedited by a portable service station designed and built by J. S. Barrett, welding foreman for the contractor, Prado Constructors, Inc. The station is a truck, with a bed of ample proportions to accommodate tanks for grease, oil, cleaning solvent, waste oil, gas and water, an air receiver, a compressor, a 3-kw. generator, an 85-hp. engine, and a cabinet at the rear for the necessary hose, guns, and other tools. All feed and return lines are carried under the truck bed to keep the deck clear for loading and unloading, the return lines running directly to the cabinet where all connections are made and in which all switches, valves, and controls are located, together with a heating element which serves to keep the grease in the long hose from getting cold and stiff. During cold weather, oils and greases are kept warm by barrel heating elements taking power from the generator, which also furnishes light for night work. Lubricants so treated penetrate more readily than when they are cold and are said to prevent sluggish gun action and air locks in guns. All compressed air used is cleaned and freed of moisture, the several air lines leading to the tanks and attached to the guns taking off from the separator, which is directly beneath the air receiver.



Courtesy, Western Construction News

SERVICE STATION ON WHEELS

This plan view shows the compact arrangement of the tanks and equipment mounted on the 8x16-foot truck bed. All service lines are carried underneath to keep the deck clear for loading.

Deep Nonmetallic Mines

AN INDICATION of the great increase in the efficiency and economy of underground mining is found in the fact that several common and inexpensive nonmetallic substances are now produced from deep levels. The International Salt Company has a mine in New York State that can hoist 3,000 tons of salt a day from a depth of nearly 1,100 feet below the surface. The room-and-pillar method is practiced, about 37 per cent of the material being left in place to support the overlying rock. No timbering is required, and no water or gas has been encountered. The property has been successfully worked for many years, and miles of drifts have been driven. The shops and even the mine office are located underground.

Limestone is being obtained at several places in Pennsylvania from depths of 500 to 600 feet; and there is a mine in West Virginia that has an adit through which a car can be driven for more than a mile and practically up to the working faces. All previous depths attained in producing this much-used mineral will be exceeded by a new project being launched by a subsidiary of the Pittsburgh Plate Glass Company. It calls for the sinking of two shafts, 2,250 feet deep, near Barberton, Ohio, to exploit a 50-foot bed of high-grade limestone. It is expected that it will take two years to develop the mine to the point of capacity production, or 300 tons an hour.

Grand Coulee Dam

GRAND Coulee Dam, the greatest block of concrete ever cast, is more than 98 per cent completed. After seven and a half years of construction, the huge barrier on the Columbia River is nearly ready to go into service. By July, according to present expectations, the first of its giant turbines will deliver power; the second unit will be on the line by October; and the third by March, 1942. Eventually, when its two power plants are fully equipped, Grand Coulee will be the world's largest generating station and will produce 2,700,000 hp.

Many notable marks have been set in the rearing of this 25,000,000-ton barricade. In a single day—May 25, 1939—an aggregate of 20,694 cubic yards of concrete was mixed and placed in the dam. During the entire month of October, 1939, concrete was deposited at the rate of 1 cubic yard every five seconds—536,264 in all. At the beginning of the current year, all but a small percentage of the total 10,500,000 cubic yards had been poured.

During the construction period, 57,000 carloads of materials have been moved to the site, and the equivalent of 5,700 additional carloads has been transported by trucks. Cement, shipped in bulk from five plants, arrived at the rate of 50 cars a day for a long time, and reached a peak of 100 cars. Compressed air served to pump it through 6,400 feet of piping to the mixing plants. Up to January 1 of this year, cement deliveries reached 40,678 carloads.

To obtain the aggregates necessary for making concrete, 39,500,000 tons of sand and gravel were excavated and passed through the screening plant. The diesel-engined locomotives that hauled the concrete out on steel trestles for pouring traveled 480,000 miles, having made 580,000 round trips between the mixers and the placing zones. Each of the twenty units pulled 100 buckets on a full trip.

Only one of the two projected power houses at the base of the dam is now being built. It is 700 feet long and as high as a 20-story building, although most of it is underwater. It has windows made of glass blocks—10¼ tons of them—held in 17 tons of aluminum frames. Each of its nine generators will produce 150,000 hp. of electrical energy. The first one is now being shipped from the East in 57 cars!

Grand Coulee Dam will form a lake that will extend for a distance of 151 miles to the Canadian border and will contain 10,000,000 acre-feet of water. Two months' average flow of the Columbia River will fill it. The reservoir area is being denuded of everything that will float. The ultimate purpose of the dam is to furnish water for irrigating 1,200,000 acres of land. To do this, the water must be lifted 280 feet from the impounding basin and delivered to twelve tunnels that will carry it through high ground to a balancing reservoir 1.7 miles from the dam. Twelve pumps, two of them spares and each large enough to handle the entire water supply of New York City, will perform this service.

Floating Power Plants

FLOATING power plants that can be moved on coastal and inland waterways to augment established land facilities may be utilized to aid the national defense program, according to one of the engineers of the General Electric Company. He disclosed that studies are being made of a 50,000-kw. plant of this kind. Inasmuch as numerous large installations have been made on ocean liners and battleships, there are no new problems involved, and the construction would follow standard marine and land central-station practices.

Even the idea is not new, for in 1929, when Tacoma, Wash., suffered a power shortage because of low water in its hydroelectric supply system, the turbines of the battleship *Lexington* were temporarily hooked up with the municipal distribution lines. Since 1930, the Public Service Company of New Hampshire has had in use a 20,000-kw. floating power plant. It was created by placing two 10,000-kw. turbogenerators in the *Jacona*, a ship built during the first World War. It is now stationed on the Piscataqua River near Portsmouth, N. H.

It has been determined that a 50,000-kw. plant could be housed in a hull less than 300 feet long and with a 10-foot draft. A few vessels of this type could be quickly put in service to tide over local land stations until additions could be built, and because of seasonal variations in power consumption could also be transferred from place to place in the course of a year as peak loads in the areas demanded.

FEATS & FACTS

ROBERT GLUECK

IT IS REPORTED THAT A MACHINE NOW BEING DEVELOPED WILL SCAN A DRAWING PHOTOELECTRICALLY, TRANSLATING ITS LINES INTO MOVEMENTS OF THE CUTTING TOOLS TO FORM AND TURN OUT THE FINISHED METAL PART.

A SHOVEL EQUIPPED WITH A FOLDING SEAT TO PERMIT OCCASIONAL RESTING IS THE INVENTION OF THE ALPHABETICAL SHOVEL COMPANY.

THE LATEST CRUDE-OIL CRACKING PROCESS AND THE ADDITION OF ETHYL TO GASOLINE SAVE US EVERY YEAR ABOUT 1,000 TIMES AS MUCH POWER AS IS PRODUCED BY ALL THE VAST DAMS OF THE T.V.A.

UNCLE SAM IS SPENDING $50,000,000.00—MORE THAN SIX TIMES THE ORIGINAL COST OF THE TERRITORY—TO DEFEND ALASKA. 24 HOURS A DAY, SIX DAYS A WEEK, ARMY ENGINEERS ARE MOVING FROZEN DIRT AT 30° F. BELOW ZERO, BUILDING LANDING FIELDS, AMMUNITION SHEDS, HANGARS, AND BARRACKS. MATERIALS FOR THE TWO-MILE-SQUARE ANCHORAGE ARMY BASE (COST—$13,000,000.00) ARRIVE AT THE RATE OF 1,000 TONS A DAY. ITS 10,000-FOOT RUNWAYS WILL ACCOMMODATE THE ARMY'S BIGGEST PLANES. THREE OTHER BASES HAVE ALSO BEEN STARTED IN THE FROZEN NORTH.

200 TO 500 TONS OF RUST IS SOLD MONTHLY BY A LARGE EASTERN RAILROAD TO VARIOUS STEEL COMPANIES WHO USE IT IN THE MANUFACTURE OF PIG IRON.

Industrial Notes

A zipper lining for Skullgards that protects every part of the head, neck, and ears against cold and snow has been announced by the Mine Safety Appliances Company. It is made in two parts: a skullcap, that is laced to the sweatband of the hard hat, and earlugs that are attached to the cap by zippers. The hood is made of water-repellent Grayfall cloth lined with woolen material.

Minute traces of solvent vapors around dry-cleaning, metal-degreasing, and a wide range of chemical equipment can be detected by a hypersensitive photoelectric cell or electric eye, according to a recent announcement made by the du Pont Company. The device is portable, and permits testing the air two or three times a minute to prevent accumulations that might prove harmful. It is claimed that it can determine the presence of two drops of solvent in a room of average size.

In a new airtight drier for bulk materials, the stainless-steel drum revolves in a trough fitted with steam pipes or gas or electric connections. These serve to heat the drum with its contents as it turns; and as drying proceeds, the air is exhausted from the shell by means of a vacuum pump. The unit is made by L.O. Koven & Brothers and is named Vacuum Dryer.

Sirens play an important part in these days of aerial warfare, and to be suitable must be capable of producing far-reaching sounds. In one type made by the Northern Electric Company, Ltd., the audible vibrations are caused by a rotor alternately expelling and cutting off the flow of air through radial ports in the stator, the tone ascending and descending the scale by increasing and decreasing the speed of the rotor. A 7½-hp. unit of this kind has an effective range of from 2 to 3 miles.

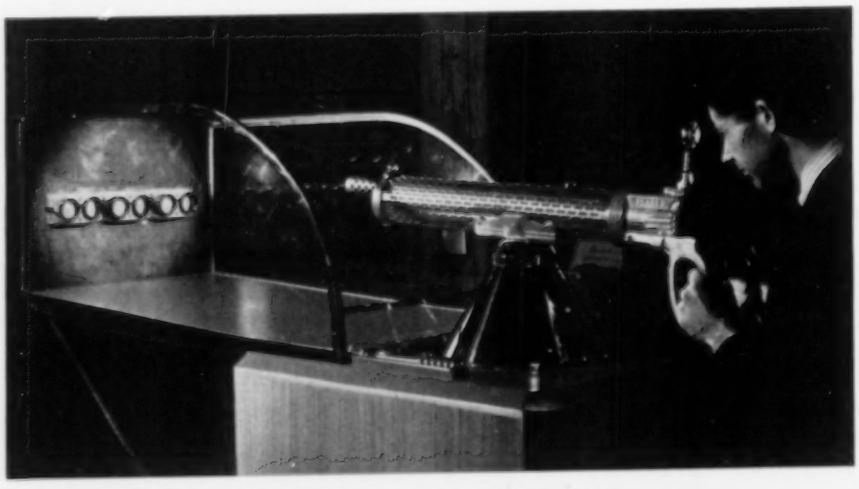
Bimetal tubes are being made by the Bridgeport Brass Company for use where service conditions inside and outside of the piping are such as to require different metals. They come in sizes up to 2 inches, outside diameter, and in a wide range of combinations to meet varying needs. Copper and steel, for example, are suitable for oil refining—fresh water passing through the copper tubing which would be affected by the corrosive oil vapors to which the steel is exposed. For circulating salt water, the inner tube would be made of admiralty metal, etc., etc.

Growing cotton to specifications sounds like magic; but we are told that it has been done and that 3,000 bales were shipped last fall to the cord mills which supply the Akron, Ohio, tire manufacturers. The story goes back five years, when the enterprising manager of a large plantation conceived the idea and proposed to grow cotton to order—that is, with a fiber of specified length and thickness. The tire makers told him just what they wanted; and, to make a long story short, the manager began to breed plants and developed a strain with the desired characteristics.

Metallurgists will be interested in a new flame-test method for metals which makes use of a test tube, half filled with glycerine, instead of the customary platinum wire. To obtain best results, the end of the tube should be dipped into concentrated hydrochloric acid, then into the powdered sample, and back again into the acid. Aside from dispensing with high-priced platinum, the method makes it possible to test heavy metals that destroy platinum, the resultant flames being so distinctive as to serve for identification. Furthermore, the flame is large and enables even inexperienced workers to distinguish the colors such as lilac for antimony, livid blue for arsenic, royal blue for tin, etc. In each case there are definite flame and other characteristics that make identification easy. Lead and zinc give no flame coloration with this glycerine-tube method.

Floor space in garage buildings can be increased 20 per cent by staggering the floors so that those on one side of the structure are midway between and overlap the floors in the other half. A garage of this type has been erected for the electrical department of Los Angeles, Calif. There is a nominal height of 17 feet between floors, and this permits the city's largest trucks to be housed in the middle of the building where the floors overlap and where the concrete ramps are located. These are 19½ feet wide, 34 feet long between floors, and have a gradient of 1 in 5 curved and banked for a speed of 30 miles an hour. The garage has storage space for 400 cars and trucks.

Although it will probably continue to be called a wire saw because of usage, the name has become a misnomer as the result of recent revolutionary changes in the medium by which certain stones such as slate and marble are quarried. The familiar type of saw is a 3-strand steel wire, 3/16 or ¼ inch in diameter, that travels over pulleys like an endless belt. Where it comes in contact with the rock and forms a groove it is fed water and grains of sand, which are the teeth of the saw. In its latest form, according to the U.S. Bureau of Mines, it is made of a ribbonlike strip of hard steel that is twisted in order to increase the sand-carrying capacity and, as it becomes worn, to retain the abrasive particles. Every 25 feet the twist is reversed to insure straight sawing. It is claimed that operations can be greatly speeded up with the new saw—in fact, that it cuts marble nearly twice as fast as does wire, or at about half the cost.



AIR GUN TESTS GOGGLE LENSES

By selecting a suitable type of glass and annealing it by recently developed methods it is possible to caseharden lenses used in safety goggles, thus making them more effective as a preventive against industrial eye accidents. Lenses are now made that will stand up under a barrage of ⅝-inch steel balls, weighing 0.57 ounce each, fired at a range af 40 inches under the pressure of 28 pounds of compressed air. The gun is shown in action at the plant of the Bausch & Lomb Optical Company in Rochester, N. Y. This new test, which closely simulates the effect of flying chips, supplements the older one of dropping balls on the lenses. The process of hardening glass has been so improved that it is now feasible to grind prescriptions into the lenses. Previously it has been necessary for workmen to wear their regular glasses under safety goggles.

15-ton splash
launched by a half-inch rubber hose

A typical example of Goodrich improvement in rubber

BEFORE you could spade a flower bed this giant truck can zip 15 tons of rock from excavation to dam embankment. But then how unload it without hours of back-breaking labor?

To dump it by tipping takes 1000 pounds of hydraulic pressure to lift the load. This pressure requires a flexible tubing to adjust itself to the moving truck body. Flexible metal tubing was tried—and broke.

B. F. Goodrich whose very first product 70 years ago was hose, had developed a rubber hose reinforced with wire for many uses in industry. Would this be strong enough?

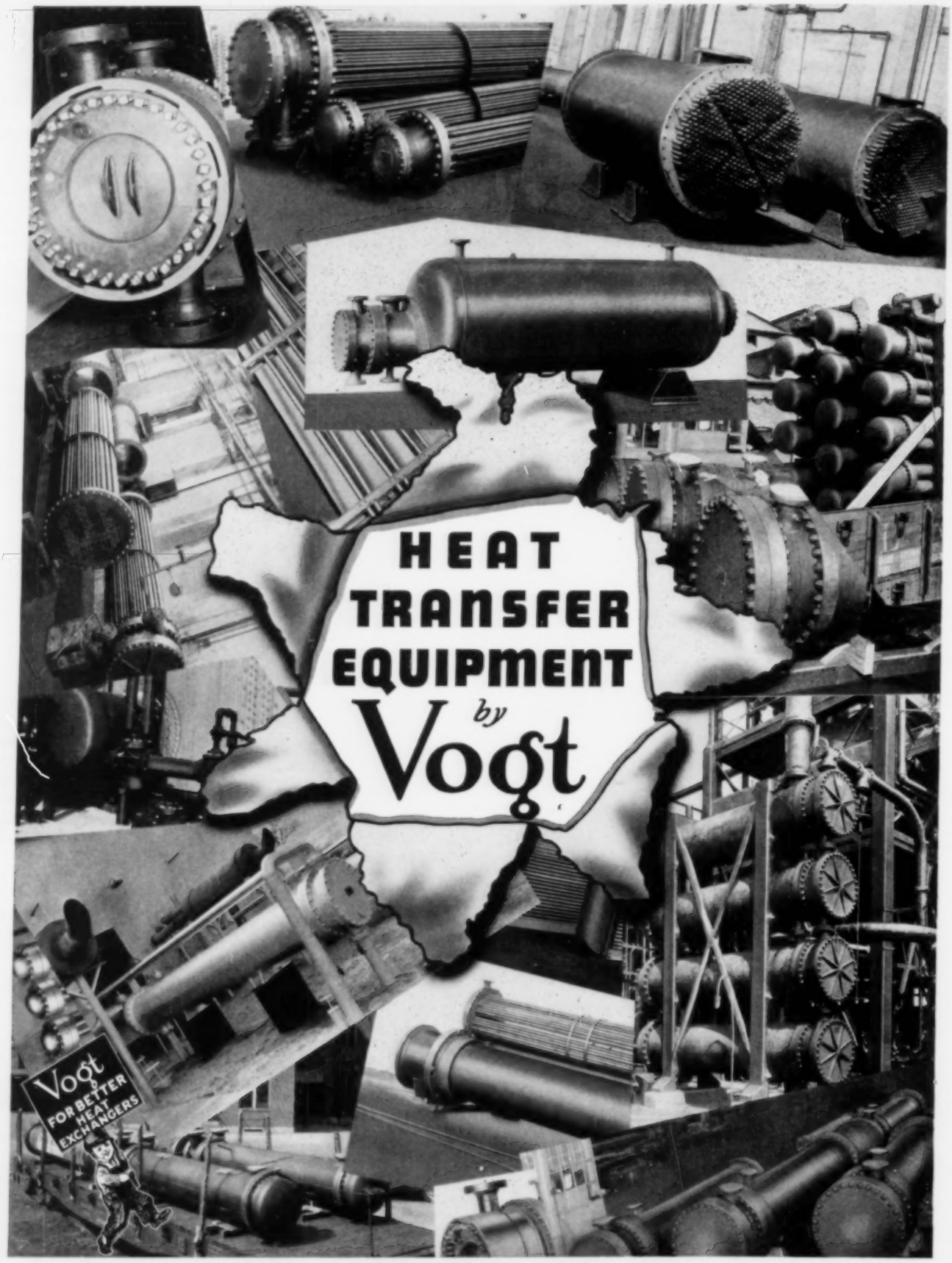
But 1000 pounds is a lot of pressure—it forces wire wrapping of most hose to unwind which lets the rubber expand and burst. Goodrich engineers began experiments for stronger hose. Using steel wire as fine as a hair, they developed a new way of braiding it in the hose, using a fifth of a mile of wire for every foot of rubber tubing. No matter how suddenly the pressure is applied this wire cannot unwind—the rubber is always clamped in a mesh of steel.

One touch on a lever by the truck driver and a thousand-pound heave pours through this new Goodrich hose . . . up goes the huge truck body, and out pours its 15-ton load.

It takes less than six feet of the hose per truck. But Goodrich research is applied to small jobs as well as large, standard products as well as new developments. Whatever rubber product you use, it pays to find out from your Goodrich Distributor what improvements Goodrich has made in it recently. *The B. F. Goodrich Company, Mechanical Goods Division, Akron, Ohio.*

B.F. Goodrich

First in Rubber



HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY.

NEW YORK · PHILADELPHIA · CLEVELAND · CHICAGO · DALLAS

INLET END
Bell mouth reduces aeration.

LEAD SLUG AND FIBRE BOND BUSHING
Crane recommended assembly . . . showing inlet end of tube with John Crane Style Lead Slugged Fibre Bushing accurately machined to fit tube size and tube-sheet drilling—a successful bond.

OUTLET END
(re-placing ferrule)
Showing patented John Crane Style 601-E Endless Metallic Rings (wrapped babbitt foil) and Style 602-G Graphite Fibre Rings (vulcanized fibre; the swelling member). When caulked these rings flow inwardly around the tube, and outwardly into the drilling threads, forming a perfect metallic bond between tube and tube-sheet.

Who knows what about Condenser packings?

John CRANE! . . .

Why? 10,000 INSTALLATIONS

IN WORLD-WIDE MARINE and STATIONARY SERVICE

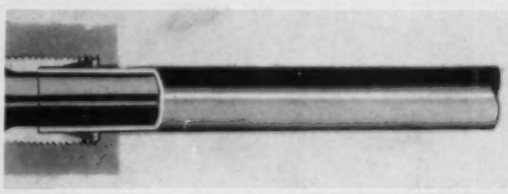
11 *success-points:*

- prevents tube-creeping at inlet end
- replaces ferrules
- accommodates expansion-contraction
- reduces electrolytic deterioration of tube ends
- seals tubes in heat transfer equipment
- facilitates tube replacement
- outlasts tubes
- avoids deforming of tube ends
- resistant to chemicals
- simple installation
- cuts retubing, repacking costs

UNIVERSAL ACCEPTANCE:

(Stationary)	*(Marine)*
Ford Motor	United Fruit
New York Edison	Standard Oil
Pennsylvania Railroad	Matson Navigation
Goodyear Tire & Rubber	American Hawaiian Steamship

Steam plant efficiency depends upon condenser operation, which depends upon tight seal—*which depends upon packing*—and Crane *KNOWS WHAT* packings are the perfect sealing mediums! Here they are: John Crane Style 601-E Metallic Packing and Style 602-G Fibre Rings are caulked into position, and bond the tube to the tube-sheet in a tight, leakproof joint, eliminating ferrules. Methods of installation (including High Pressure Heater Tube Packing) are detailed in Catalog. No. 50.



JOHN CRANE "METAL-TO-METAL" TUBE FITTINGS provide permanent fixation of tubes: no more bowing, fracturing, leaking, deformity; permit removal of tubes from either end; renewable; . . . *the modern, correct medium for "tight" condensers;* available for 4 special adaptations . . . (used by leading naval powers).

CRANE PROBLEM COUNSEL

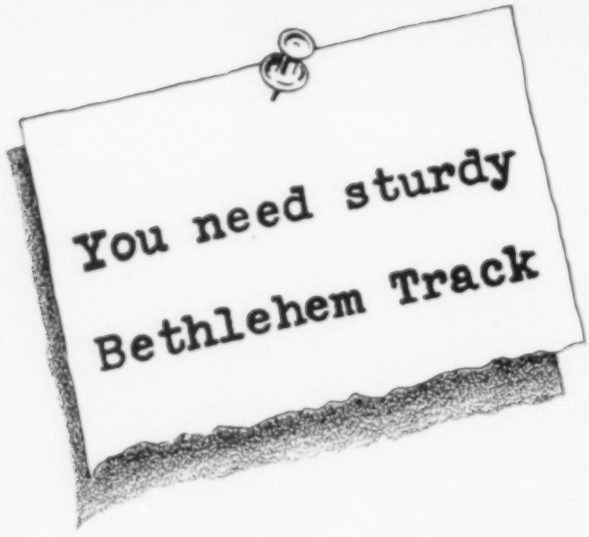
is offered without obligation. Surveys, analyses and recommendations made by our research laboratory on any packing problem or need. Special packings for specific services.

CRANE PACKING COMPANY, Chicago, U. S. A. CA-341
CRANE PACKING COMPANY, Limited, Hamilton, Ontario, Canada

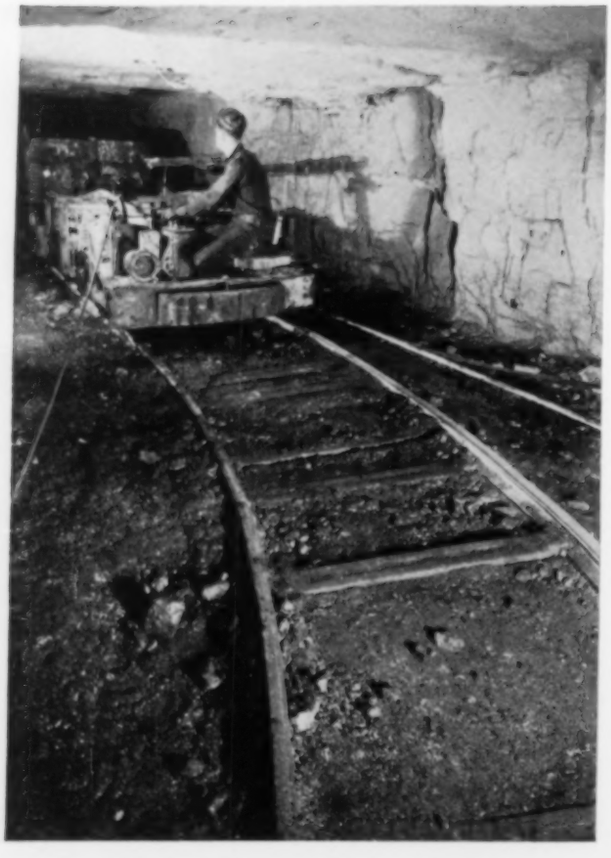
NAME_____ TITLE_____

ADDRESS_____ COMPANY_____

CITY OR TOWN_____ STATE_____



UP ABOVE OR WAY DOWN UNDER



. . . In open pit, deep mine or quarry, it's the haulage system that has the last word to say about production. For right there is where most production-killing bottlenecks occur, whether from breakdowns of unsuitable track equipment or from time out due to faulty track layout at the loading end. Eliminating that second kind of bottleneck isn't always so easy. But there's an easy, practical remedy for the first, and one that will save you money as well as time.

In Bethlehem Heavy-Duty Mine Track Equipment, progressive operators the country over have found a positive, economical answer to their haulage problems. Made to stand up under the heaviest loads, designed to take the most gruelling punishment, Bethlehem Heavy-Duty Steel Ties, Rails, Switches, Crossings and Turnouts will still be giving trouble-free service long after light equipment has had to be replaced. By using these rugged units, you can cut maintenance and replacement costs to a new low, and enjoy smoother operation, increased production and greater profits in the bargain.

Write to Bethlehem Steel Company, Bethlehem, Pa. for your free copy of booklet 72A.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

A STARTLING *New* DEVELOPMENT

full of MONEY-SAVING FEATURES

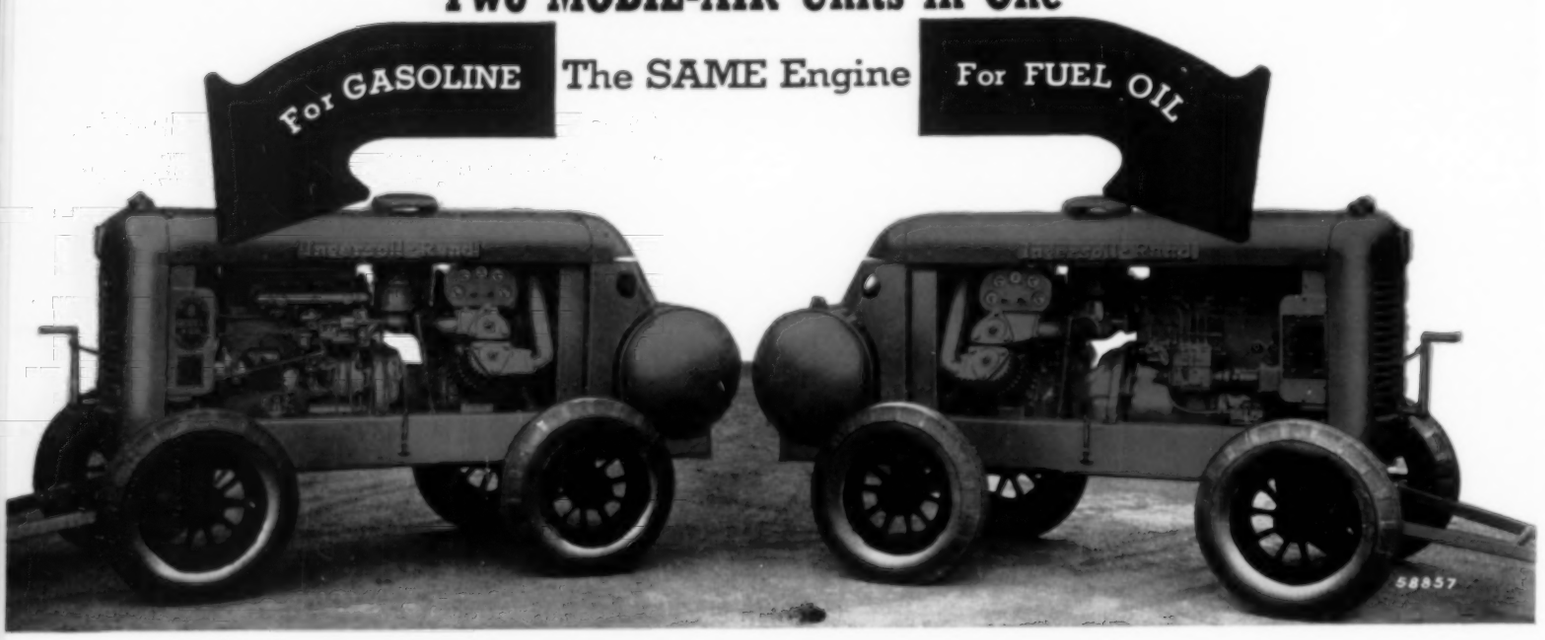
Another New Standard in
Portable Air Compressors

See Next Page

by **Ingersoll-Rand**

The New Standard in PORTABLE AIR COMPRESSORS

Two MOBIL-AIR Units in One



The MOBIL-AIR has a Convertible Engine . . . You can change from oil to gasoline operation (or from gasoline to oil) by a simple substitution of fuel accessories . . . in your own shop . . . no changing of engines or engine heads or pistons. The engine has overhead valves, replaceable cylinder liners, non-sticking piston rings and other refinements.

See Previous Page

As a Gasoline Engine this outstanding new development requires much less fuel . . . particularly at light loads.

As an Oil Engine it is the well-known Ingersoll-Rand Type H . . . smooth running, easy to maintain, easy to start.

DRILL-MORE Multi-speed Regulator (patented) adjusts the engine speed to the use of air . . . practically eliminates wasteful "idling." The average working speed of the engine and compressor is reduced . . . more efficient operation . . . less wear.

More Work from Air Tools . . . Jackhamers and similar air tools drill up to 15% faster when the compressor is equipped with the DRILL-MORE Regulator.

Remarkable Fuel Economy . . . up to 40% less fuel to do an average job. The new Two-Stage Air-Cooled Compressor, the new High-Economy engine, and the new DRILL-MORE regulator result in 15% more air per gallon of gasoline at full load—83% more at half load.

New-Type Clutch has automatic take-up . . . no sliding splines . . . easy to inspect and reface.

New Instrument Panel, Grouped Controls and many other distinctive features.

Lighter in Weight . . . Easier to Handle . . . 15 to 33% less weight than previous models.

New Mountings . . . Both the 105- and 160- cu ft sizes are now available in the 2-wheel deluxe trailer mounting . . . the 210- and 315- cu ft sizes have a new spring mounting with automotive steering as standard.

Ask our representative for details . . . let him show you the many other points of superiority.

A Complete Line of Two-Stage Air-Cooled Portable Compressors

Sizes 60 to 500 cfm (actual free-air delivery)

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY 999-2

Branches or Distributors in Principal cities the world over.

Kansas City, Knoxville, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, St. Paul, Tulsa, Washington

Montreal, Mexico, Havana, Rio de Janeiro, Lima, London, Paris, Madrid, Lisbon, Budapest, Melbourne, Calcutta, Johannesburg and many others.

"TOLEDO"

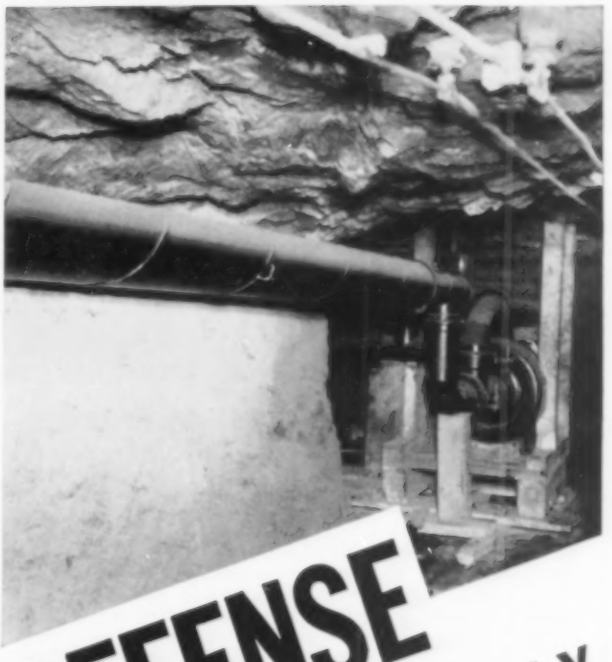
TRADE-MARK REGISTERED U.S. PAT. OFFICE

ROCK DRILL ROD THREADING EQUIPMENT—EITHER HAND OR POWER OPERATED. EFFICIENT, EASY OPERATING PIPE STOCKS AND DIES, BOLT DIE STOCKS, POWER PIPE MACHINES, PIPE REAMERS, PIPE VISES, VISE MOUNTS.

SEND FOR LITERATURE AND 1941 "TOLEDO" CATALOG

THE TOLEDO PIPE THREADING MACHINE CO. TOLEDO, OHIO

NEW YORK OFFICE, 502 No. 2 RECTOR STREET BLDG.



DEFENSE AGAINST COSTLY MINE AIR LINES!

● Naylor is the one light-weight pipe you can depend on for both high and low pressure air lines. Its exclusive Lockseam Spiralweld structure enables it to carry loads usually requiring heavier-wall pipe, at the same time providing the definite savings of light weight. Sizes from 4" to 30" in diameter. Complete fittings and fabrication service to meet any mine requirements.

Write for Naylor Catalog or send specifications for quotation.

NAYLOR PIPE COMPANY
1245 EAST NINETY-SECOND STREET
CHICAGO, ILLINOIS

NAYLOR LOCKSEAM SPIRALWELD PIPE

YOUR FIGHTING FRONT

Willson Approved Respirators Nos. 5 and 5L are identical except for different types of filters. No. 5 is for pneumoconiosis-producing dusts and mists and chromic acid mist; No. 5L is for toxic dusts such as lead, cadmium, antimony and arsenic.

Respirators are an indispensable ally in the battle to protect workmen under increased pressure of industrial activity. Respirators alone are not the answer. They must give comfortable protection to assure their being worn. WILLSON Respirators are especially designed to give comfort as well as protection. WILLSON has more U. S. Bureau of Mines approvals than any other manufacturer. There is a WILLSON Respirator for every conceivable industrial use. Consult your local WILLSON Safety Service Representative or write for catalog.

DOUBLE WILLSON PRODUCTS INCORPORATED READING, PA., U.S.A. Established 1870

GAS MASKS
RESPIRATORS
GOGGLES
HELMETS

50 YEARS' EXPERIENCE

Sheet Metal Fabrications
Stamping
Machine Work
Electrical Assembly
Wiring and Testing
Welding
Paint Finishing
Products Completely Manufactured

They* were going to draw this X-ray Control Housing 14" x 7" x 7". Dies to properly handle ⅛ inch steel cost $4200. We were asked to suggest something. We said—"Fabricate it at a tooling cost of $140". The Manufacturing cost proved to be in line, precision held was + or − .005, the customer saved a lot of money.

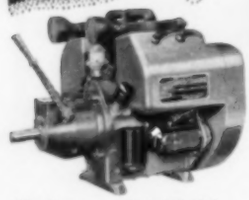
Perhaps your product too,—or part of it—could be fabricated, with comparable savings. It's well worth thinking about and enquiring about. Especially these days with die-making at a premium. Also out of that wide range of specialized skills listed in the box at the left we might engineer other valuable product improvements and economies for you.

*(Name upon request)

BIG *names in American Industry are customers of ours—for many years too!*

LEWYT METAL PRODUCTS CO. Inc.
60 Broadway Brooklyn, N. Y.

Two cylinder Ingersoll Rand compressor, powered by Wisconsin Heavy Duty Air-Cooled Engine



12 sizes . . . 1 to 35 H.P.
Model V-E4 illustrated.

Any climate, any season, any job . . . Wisconsin heavy-duty air-cooled engines supply the steady, dependable "power push" to carry on . . . no matter how tough the going!

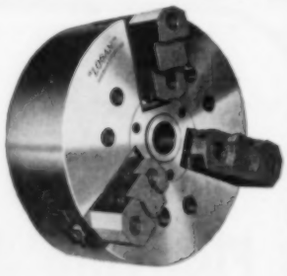
Find out for yourself just HOW DIFFERENT Wisconsin engines really are. Details on request. Write Dept D-3

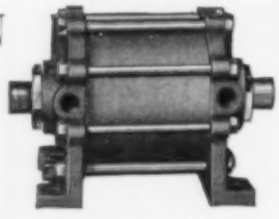
MOST POWER PER POUND
HEAVY-DUTY AIR-COOLED ENGINES

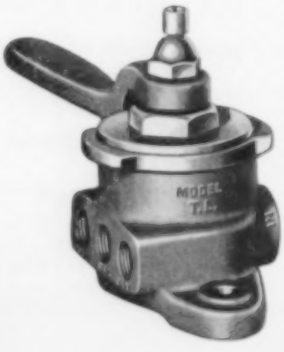
by WISCONSIN MOTOR CORPORATION
Milwaukee, Wisconsin, U. S. A.

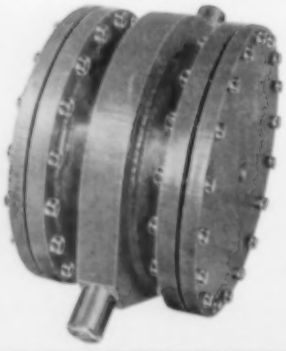
World's Largest Builders of Heavy-Duty Air-Cooled Engines

FOR 25 YEARS *"LOGAN"* Air Equipment Has Saved TIME • EFFORT • MOTION







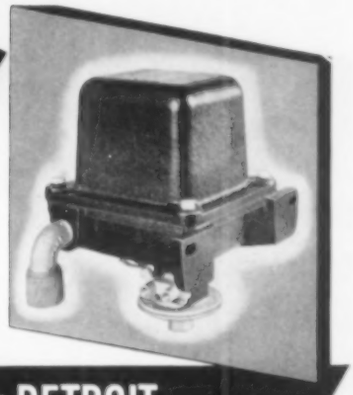


THIS year marks "LOGAN'S" twenty-fifth anniversary. During those years "LOGAN" has solved production problems and speeded up manufacturing in most of the largest industrial plants in the world. And now in these days of great stress "LOGAN'S" entire resources and manpower are being devoted to the defense of America in her Armament Program. Let "LOGAN" Representatives and "LOGAN" Engineers make recommendations on your production problems.

LOGANSPORT MACHINE, INCORPORATED
920 Payson Road Logansport, Indiana

Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

HERE IS AN *Explosion-Resisting* PRESSURE SWITCH



● The **CLASS 9013 TYPE AR** switch is built for use in Class I Group D hazardous locations. Top pressure 225 lbs.—standard air compressor settings—with or without release valve. Ratings are 2 H.P. 110 V., 3 H.P. 220 V. single phase and 5 H.P. 220-550 V. polyphase.

SWITCH • PROTECT • REGULATE • DO IT ALL WITH SQUARE D

SQUARE D COMPANY • REGULATOR DIVISION • DETROIT

MAXIM SILENCERS

for

SELECTIVE SILENCING

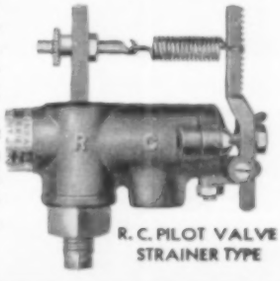
Maxim's broad line of silencing equipment gives you greater selectivity . . . the advantage of choosing a silencer built to fit your particular requirements. It will pay you well to investigate.

Send for details.

THE MAXIM SILENCER CO.
85 Homestead Ave. HARTFORD, Conn.

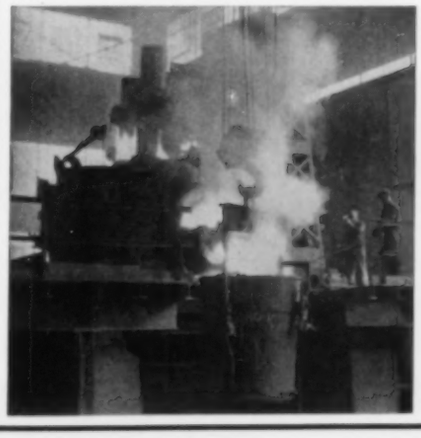
R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders



Control

—right from the start for—

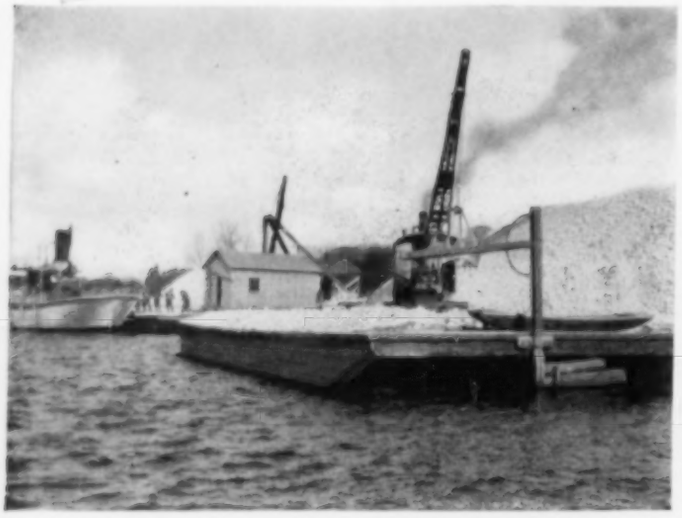
BASIC ELECTRIC STEEL FORGINGS

COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications–Smooth Forged, Hollow Bored, Rough or Finished Machined.

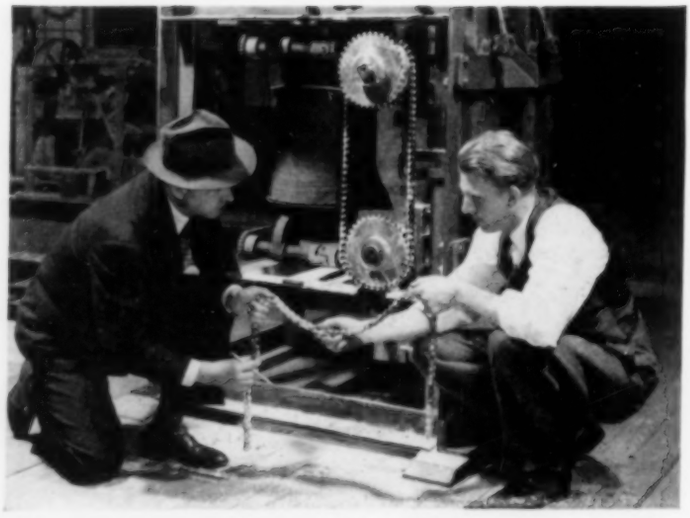
NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA. U. S. A.

READ Solved—

HOW AMERICAN NEPHELINE CORPORATION DID IT WITH ALLIS-CHALMERS TEXROPE V-BELT DRIVE EQUIPMENT!

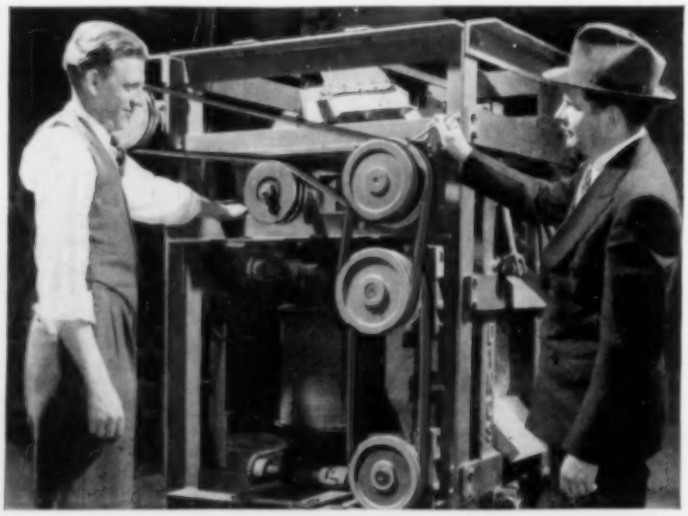


1 DISCOVERED! A NEW ORE TO REPLACE FELDSPAR AS A flux in glass-making and other ceramic industries! Found commercially only in Ontario, the new material — Lakefield Nepheline Syenite ($Na_2O\ A1_2O_3\ SiO_2$) — contains as much as 24 per cent of the flux-quality, alumina. To prepare it for market, in the modern plant of American Nepheline Corporation in nearby Rochester, N. Y. . . .



2 THE IRON CONTENT OF LAKEFIELD NEPHELINE SYENITE must be reduced from one percent to a negligible amount. Called in by American Nepheline to solve this problem, the Dings Magnetic Separator Co., Milwaukee, faces a problem of its own — powerful iron-removing magnetic action attracts chain drives, draws them to the magnet side of their sprockets, wears them out in short order!

3 RECALLING OTHER SUCCESSFUL APPLICATIONS OF TEXrope Drives, Dings' officials invite in Allis-Chalmers engineers. Soon these trained engineers offer Dings' Bill Soli their solution — Texrope Drives engineered for their particular job . . . completely compact and positive, and — in no way vulnerable to the effects of Dings' magnetic action! Dings officials then observe how . . .



4 TEST RUNS USING TEXROPE DRIVES IN THE LABORATORY uphold their hope for greatly increased drive efficiencies. Without delay, four Dings units are equipped, each with four precision-engineered Texrope Drives from the huge stock at the Allis-Chalmers plant (as carried in warehouses throughout the country) . . . shipped speedily to help prepare Nepheline Syenite. Installed . . .

TEXROPE DRIVES CUT

THE RIDDLE OF FORMULA

$Na_2O\ Al_2O_3\ SiO_2$

5 NOW IN AMERICAN NEPHELINE'S PLANT, THE FOUR Dings units operate more efficiently than ever before . . . while American Nepheline engineers observe how smooth sides of Texrope V-belts repel ore dust, resist magnet induced wear. With other Texrope-driven units, Dings Separators are now a part of American Nepheline's production, operate without costly breakdowns! —

6 GRATEFUL FOR SOLUTION OF THEIR PROBLEM, American Nepheline commends Dings Magnetic Separator Co. In turn, Dings' Bill Soli acknowledges Texrope engineering cooperation . . . praises Allis-Chalmers Texrope products . . . money-saving products that successfully solve hundreds of power transmission problems in thousands of industrial plants throughout the world!

Save Money With Allis-Chalmers Texrope V-belt Drive Equipment — the Modern Power Transmission That Gives You Silent . . . Shock-Proof . . . Safe . . . Flexible . . . Efficient Operation . . . PLUS a Cooperative Engineering Service That's Truly Cooperative!

WHEN YOU specify Allis-Chalmers Texrope Drives on your machines, you get *Double Value!*

For Texrope gives you not only an unequalled record for long life . . . low maintenance . . . and year 'round dependability — but a unique cooperative engineering service as well.

Allis-Chalmers has the longest and broadest experience in the V-belt drive field. Over a decade ago, Allis-Chalmers originated and developed multiple V-belt drives . . . has led in their advancement ever since.

That means, as transmission engineers to industry, we can work with you . . . can direct this broad experience at helping solve *your* transmission problems!

And don't forget — this Double Value is yours at no extra cost. Get the facts about Texrope . . . today. Call your nearest Texrope dealer, or write Allis-Chalmers, Milwaukee, Wisconsin.

A-1361

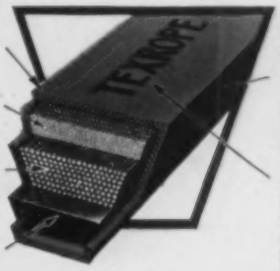
WHEN ORDERING REPLACEMENTS, REMEMBER . . . ONLY TEXROPE V-BELTS GIVE YOU ALL THESE OUTSTANDING FEATURES!

Extra-tough, two-ply cover gives EXTRA-PROTECTION against abrasive wear . . . eliminates need for belt dressing of any kind.

Special bias cut fabric adds transverse strength . . . provides DOUBLE SAFETY against belt breakage.

Rugged load-carrying cords, impregnated in a special, cool-flexing gum insure unvarying length . . . GREATER strength . . . MORE pulling power.

Amazing cool-running rubber compound absorbs shock . . . assures silent, vibrationless operation . . . ACTUALLY INCREASES BELT LIFE 100 TO 200% OVER BELTS OF ONLY A FEW YEARS AGO!



Belts by Goodrich

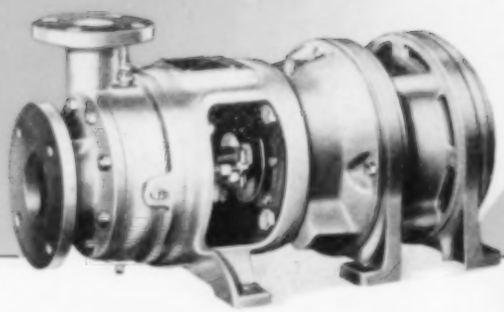
Texropes are TRUE V-BELTS . . . with famous STRAIGHT-EDGE WEDGE design that gives efficiencies up to 98.9% . . . prevents slipping, jerking. Because they are matched in a special precision measuring machine, sets of Texropes are uniform to a fraction of an inch in length — your guarantee of equalized pulling . . . even wear . . . longer life.

LOOK for the name TEXROPE . . . stamped on every belt! It identifies the only GENUINE Texrope . . . backed by Allis-Chalmers, originators of the multiple V-belt drive. You can get genuine Texropes and Texrope Drives instantly from Allis-Chalmers warehouses and distributor stocks throughout the world.

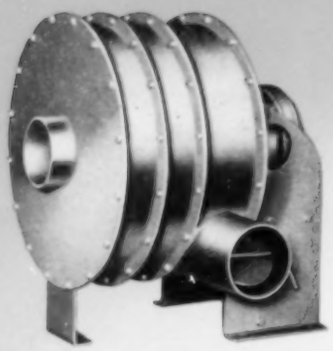
TRANSMISSION COSTS

MODERN COMPRESSED AIR

MOTORPUMPS combine the pump and motor in one unit. They operate in any position. Pressures: 5 to 215 lbs. Capacities: 5 to 1500 gpm. Catalog 7664.



TYPE "G" MOTORBLOWERS have been designed principally for supplying air to oil and gas furnaces. Volumes: 100 to 4500 cfm. Pressures: 8 oz. to 2¼ lbs. Catalog 2626.



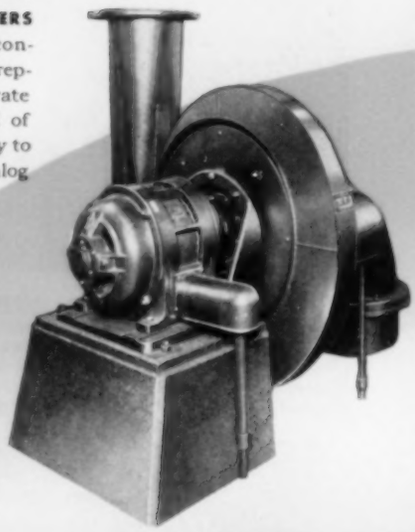
- There is real heavy work ahead for the Metal Industry, and in doing this work nothing short of the best equipment can assure uninterrupted service.

For more than 70 years, Ingersoll-Rand has pioneered in the development of air compressors, blowers, pneumatic tools, pumps, engines, condensers and a host of other machines—equipment that so many industries depend upon for their defense program work.

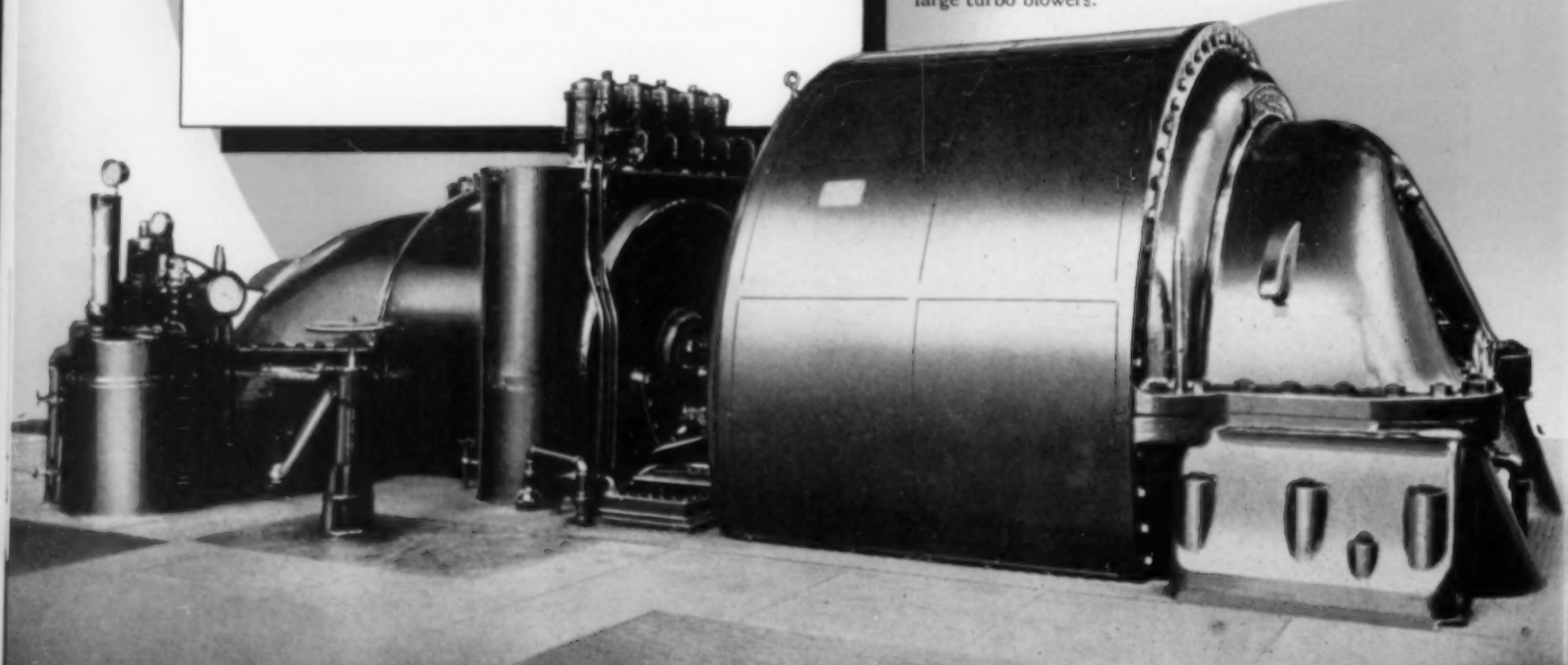
Each of the I-R units, a few of which are shown on these pages, can be relied upon for steady and efficient performance. And remember, the Company's interest in a machine or tool is continuous during its entire lifetime—that is your assurance of real service when you need it.

Perhaps an I-R specialist can help you with your production set-up. Don't hesitate to call on him. There is no obligation.

CUPOLA MOTORBLOWERS with Ingersoll-Rand constant air-weight control represent the most accurate and convenient method of insuring proper air supply to gray iron cupolas. Catalog 2145-A.

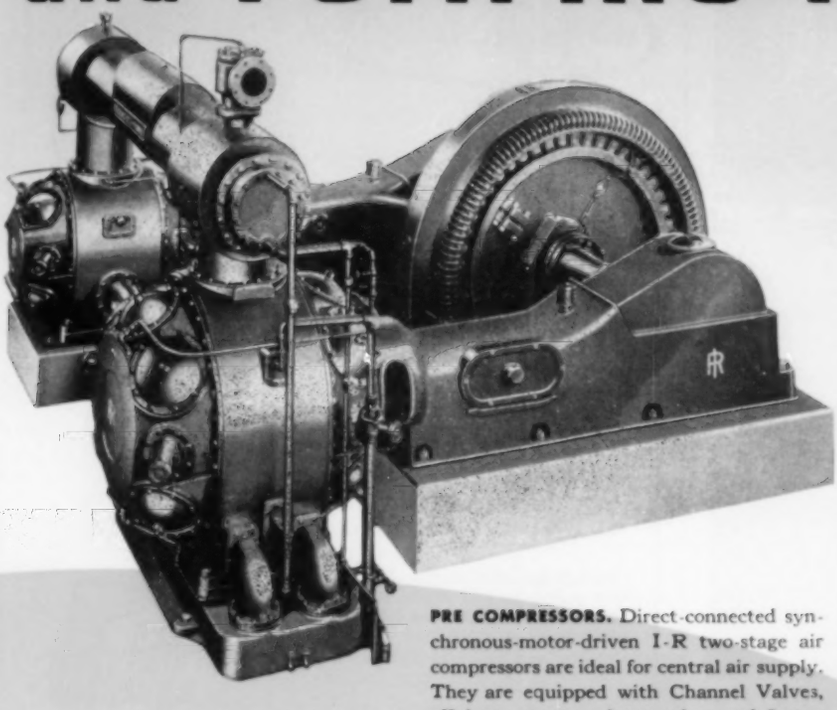


BLAST FURNACE BLOWERS. More than 100 Blast Furnace and Bessmer Converter blowers built by Ingersoll-Rand are in operation today. Unequalled building and testing facilities are employed in manufacturing these large turbo blowers.

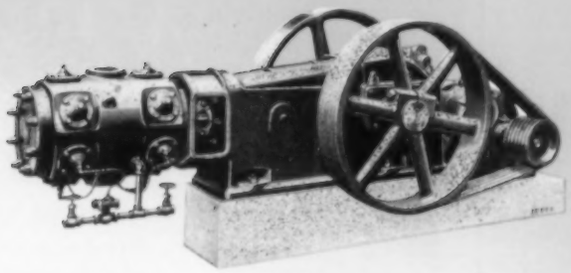


Atlanta
Birmingham
Boston
Buffalo
Butte
Chicago
Cincinnati
Cleveland
Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City
Knoxville
Los Angeles
Newark
New Orleans
New York
Philadelphia
Picher
Pittsburgh
Pottsville
Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
St. Paul
Tulsa
Washington

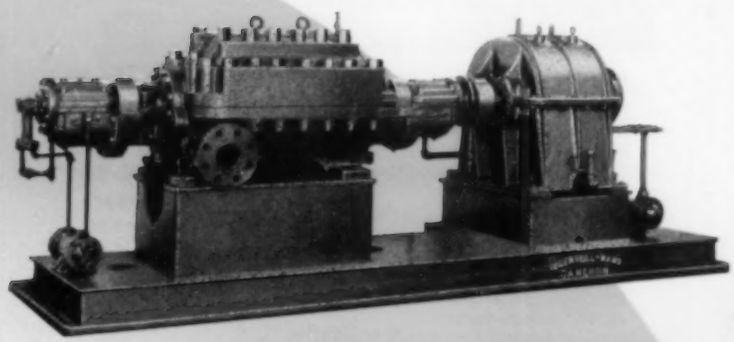
and PUMPING MACHINERY



PRE COMPRESSORS. Direct-connected synchronous-motor-driven I-R two-stage air compressors are ideal for central air supply. They are equipped with Channel Valves, efficient two-stage intercoolers and 5-step clearance control. Sizes: 200 to 3000 hp. Catalog 3426. Comparable steam-driven units available. Catalog 3444.

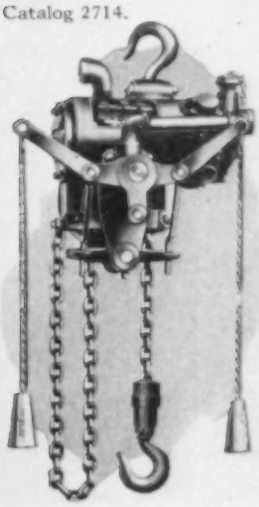


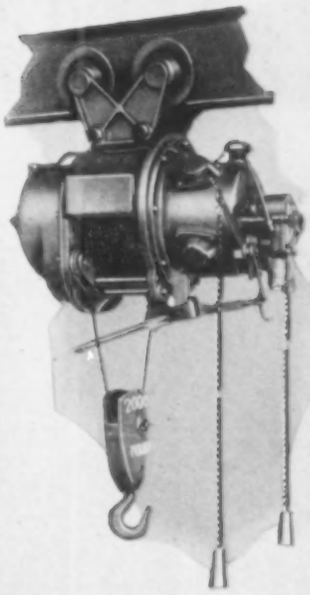
ES COMPRESSORS are heavy-duty air and gas units for a wide range of service. Pressures: 5 to 2500 lb., and vacuums. Sizes: 5 to 125 hp. Also available with steam power cylinder. Catalog 3063-B.



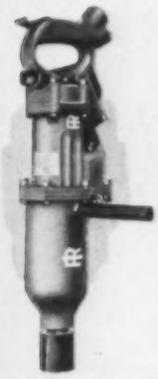
DESCALING PUMPS. Multi-stage centrifugal pumps are ideal for boiler feed and for descaling service. The complete line ranges from 20 to 3000 gpm with pressures to 1800 lbs. Catalog 7258.

THE AIR-BLOC. This modern lift for light loads speeds up production on a multitude of jobs. Capacities: 300, 500, 700 lbs. Catalog 2714.

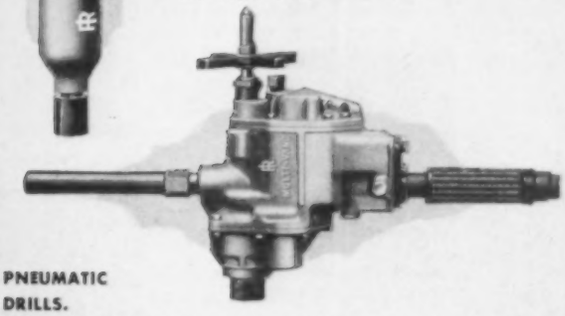




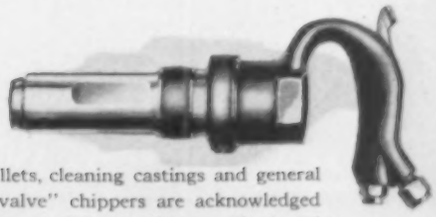
HEAVY-DUTY AIR HOISTS are built in capacities ranging from 500 to 20,000 lbs. Safest for use around the shop—trolley or hook mounting. Catalog 12100.



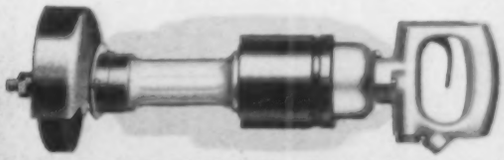
IMPACT WRENCH. This revolutionary wrench continues to show amazing economies under severe service. Reversing and non-reversing styles for every need. Catalog 12100.



PNEUMATIC DRILLS.
Complete lines of piston type and "Multi-Vane" pneumatic drills are made for all ordinary shop uses and for many special services, such as close-quarter drilling and flue rolling. Catalog 12100.



CHIPPING HAMMERS.
For chipping billets, cleaning castings and general work "flapper valve" chippers are acknowledged leaders. A wide range of sizes for light, medium, and heavy work is available. Catalog 12100.



HAND-HELD GRINDERS. "Multi-Vane" grinders are especially designed for fast work on castings and metal welds—positive control, light weight and speed variation. Catalog 12100.

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY 977-14

DEPENDABLE PNEUMATIC SERVICE

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

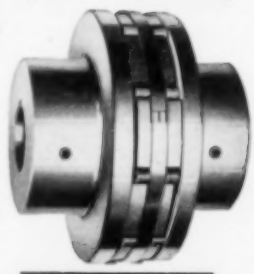
A typical installation showing DriAir standing on the floor next to the wall.

The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

No METAL-TO-METAL Contact!

NO NOISE HERE

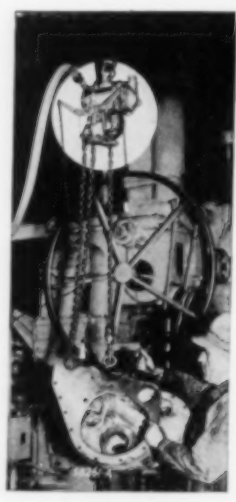


Quiet operation is one of the characteristics of L-R Flexible Couplings. They are quiet because the resilient cushion member is between the metal jaws to absorb shock, carry the load and correct misalignment. Having no metal-to-metal contact, L-R Flexible Couplings require no lubrication and are practically noiseless and service-free after many years of use.

L-R FLEXIBLE COUPLINGS

There is an L-R Flexible Coupling for all coupling jobs—for all kinds of direct drive machines. Sizes range from 3/16" to 14" bores, 1/6 to 2500 H.P. at 100 R.P.M. Write for complete Catalog and Selector Tables. Ask also about L-R's FREE technical service. Write

LOVEJOY FLEXIBLE COUPLING CO.
4951 W. Lake St. Chicago, Ill.



Serving a machine tool—a popular use for the AIR-BLOC. Note the flexible link chain which is standard.

The Air-Bloc is suitable for loads up to 700-lbs. Other I-R Hoists handle loads up to 20,000 lbs.

NEW The AIR-BLOC

Features and Advantages

1—Fitted with a flexible, welded link chain which will not break when twisted.
2—Constructed so that the load cannot drop even if the air supply fails.
3—Easy to move—Weighs less than 75 pounds.
4—Automatic Safety Up-and Down-Stop—Prevents damage to hoists from over run of chain in either direction.
5—Dust-Proof oil chamber in which all moving parts are automatically lubricated.
6—Radial airplane type of air motor gives compact construction.
7—Graduating reversing valve gives instant and complete control of the hoist action.

11 BROADWAY, Ingersoll-Rand NEW YORK, N.Y.
352-8

GELAMITE

REG. U. S. PAT. OFF.

IN THE SPOTLIGHT

Eleven years ago a new type of explosive made its debut. It was the original semi-gelatin, named Gelamite (U. S. Patent No. 1,894,144). For eleven years, we've told you about the research behind it, the money it saves, its water resistance and fumes. It has earned a place in the spotlight.

- as the **BIGGEST SELLING HERCULES EXPLOSIVE**
- as the **STANDARD** explosive for tunneling
- as the **STANDARD** explosive for metal mining
- as a **FORERUNNER** in the trend to more economical explosives

EXPLOSIVES DEPARTMENT
HERCULES POWDER COMPANY
Incorporated
WILMINGTON • DELAWARE

A-81

New!
Condor Homo-Flex Hose

AN ENTIRELY different construction makes it flexible as a rope—kinkless—tough.

Homo-Flex Hose is so light and easy to handle that you get more production with less fatigue; so strong you get more service at lower cost.

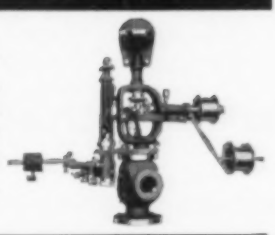
You have to see and handle Homo-Flex to realize how great is this improvement in hose construction. You have to use it to appreciate that these are understatements.

Bulletin No. 6879 is worth a "rush request." It describes the Homo-Flex types for air, water and other services.

Keep Ahead with
THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.
22 Townsend St., Passaic, N. J.

COMPRESSOR EQUIPMENT

SOUNDLY DESIGNED • STURDILY CONSTRUCTED



ERIE GOVERNORS— For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

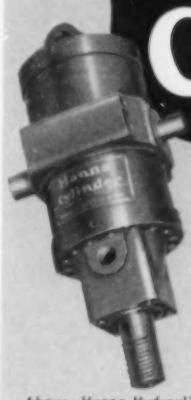
ERIE UNLOADER—Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

JARECKI VALVES—Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

JARECKI FITTINGS—Air-furnace malleable fittings...close-grained, cast iron fittings, all with perfect threads. A complete line.

JARECKI MANUFACTURING COMPANY
ERIE, PA., U.S.A.

Step up production ALL ALONG THE LINE with Hanna Cylinders



Above: Hanna Hydraulic Cylinder Model H. P. 17, one of ten standard models for every type of mounting requirement.

Above: Hanna Model 18 Low Pressure Cylinder, designed to operate at pressures up to 100 lbs. per sq. in.

STANDARD MODELS for SPECIAL JOBS!

IF your present production schedule calls for increased speed, more work per man, and greater efficiency from existing machinery, then put Hanna Cylinders on the job right now! Let these efficient units do the hundreds of jobs that now require sheer physical effort or that now depend upon obsolete methods. There is a complete line of *standard* Hanna Cylinder models ready to handle *special* jobs that call for pushing — pulling — raising or lowering, faster and more economically.

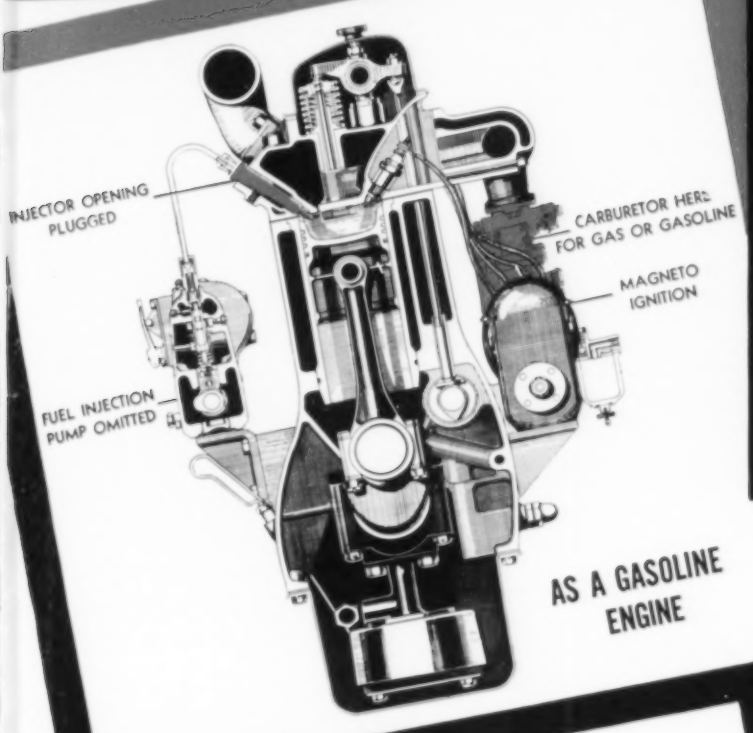
We are equipped to meet your cylinder requirements promptly. Hanna Cylinder Catalogs, No. 229 Hydraulic and No. 228 Pneumatic, give complete details. Send for them today.

- Air and Hydraulic RIVETERS
- Air and Hydraulic CYLINDERS
- Air HOISTS

Left: Hanna Model 4 Air Cylinder with mounting for horizontal or vertical power movement.
Below: Hanna Hydraulic Cylinder Model H. P. 14, arranged for pivot mounting, permitting cylinder to swing in an arc.

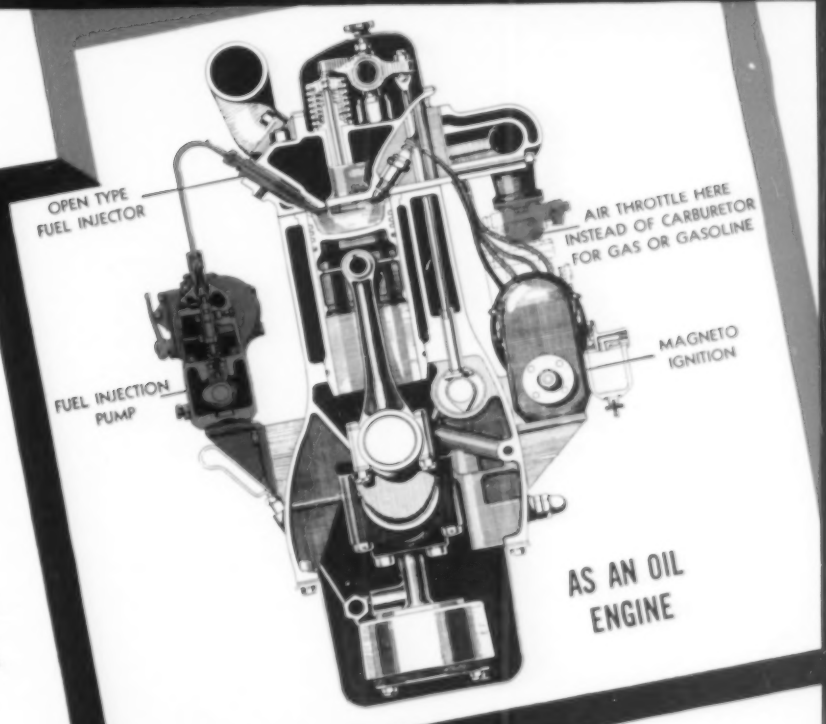
HANNA ENGINEERING WORKS
1765 Elston Avenue • Chicago, Illinois

MULTI-FUEL
the World's Most Flexible Engine



AS A GASOLINE ENGINE

Powers MOBIL-AIR
the New Standard in Air Compressors by INGERSOLL-RAND


OPEN TYPE FUEL INJECTOR
AIR THROTTLE HERE INSTEAD OF CARBURETOR FOR GAS OR GASOLINE
MAGNETO IGNITION
FUEL INJECTION PUMP

AS AN OIL ENGINE

Through the co-operation of Ingersoll-Rand and Waukesha engineers, the *world's most flexible engine* was developed for use with the new Mobil-Air Portable Compressors.

Now the contractor can change engine fuels without changing engines. This *one* engine is *all he needs*. The *Multi-Fuel Engine* burns diesel oil, gasoline, natural gas, or even bottled gas, if necessary—whichever is the cheapest or easiest to get in the locality where his compressors are operating. It's only a matter of fuel system accessory changes—not a single major item is touched.

Ten years ago the Type H Waukesha-Hesselman Oil Engine was first built for Ingersoll-Rand. This new Waukesha *Multi-Fuel* Engine used in Mobil-Air is the logical and ultimate refinement of that design.

WRITE FOR BULLETIN NO. 1173

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

WAUKESHA Multi-Fuel ENGINES

INGERSOLL-RAND

MOBIL-AIR

is Equipped with TIMKEN Bearings

Again TIMKEN Tapered Roller Bearings figure importantly in an outstanding mechanical development. The crank shaft of Ingersoll-Rand's revolutionary new "Mobil-Air" Compressor is mounted on TIMKEN Bearings to eliminate friction; prevent shaft wear; hold the crank shaft in correct and constant alignment; and provide sure protection against radial, thrust and combined loads. TIMKEN Bearings also are used in the wheels of the two-wheel model for smoother, easier, faster transportation.

Ingersoll-Rand has used TIMKEN Bearings for years; is familiar with their advantages. So the choice of TIMKENS for "Mobil-Air" was a natural one. For anti-frictionized performance at its best be sure you have TIMKEN Bearings—in compressors or any kind of equipment.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
TAPERED ROLLER BEARINGS

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.